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**INITIAL OPERATIONAL TEST AND EVALUATION
OF NEW OPTICAL-MARK-READER ANSWER SHEETS
FOR THE
ARMED SERVICES VOCATIONAL APTITUDE BATTERY
(ASVAB)**

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NOTE

This report, covering the *INITIAL OPERATIONAL TEST AND EVALUATION OF NEW OPTICAL-MARK-READER ANSWER SHEETS FOR THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY (ASVAB)*, has been produced in two sections to facilitate review.

The first section contains the preface, the executive summary, the text that discusses the procedures and analyses, the appendixes, and a list of references.

The second section, titled the *ASVAB OMR IOT&E SUPPLEMENT*, contains all tables and figures that provide information to support the discussion of procedures and analyses.

Reviewed by:

Paul P. Foley

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TABLE OF CONTENTS

PREFACE	i
EXECUTIVE SUMMARY	ii
INTRODUCTION	1
Design	2
METHOD	3
Subjects	3
Procedure	3
RESULTS	4
Data Quality Control and Editing	4
Equivalence of Groups	5
Answer-Sheet Effects: Speed Tests	5
Answer-Sheet Effects: Power Tests	7
Pooling Distributions for Tests with Answer-Sheet Effects.....	7
Calibration of Tests with Answer-Sheet Effects.....	8
Effect of ASVAB Form on Answer-Sheet Calibration.....	11
Comparison with Previous Answer-Sheet Calibrations.....	12
Conversion Table for ASVAB 8f/13h/15h/18h.....	13
Conversion Tables for ASVAB 8g/9f/9g/10f/10g/14f/14g/14h	13
Conversion Tables for ASVAB 11f/g to 13f/g and 15f/g to 19f/g	14
Conversion Tables for ASVAB 20a/b to 22a/b.....	14
Distributions of Composites of Converted Test Scores	15
DISCUSSION	16
SUMMARY AND CONCLUSIONS	16

APPENDIXES	19
A: Alternative Methods of Equating.....	19
B: Log-linear Smoothing of ASVAB Test Distributions from the Operational Calibration of ASVAB 15, 16, and 17.....	21
C: Estimation of the Lower Tail of the Test Cumulative Distribution for Equipercntile Equating.....	22
D: Choosing among Alternative Equatings.....	23
E: Composite-Category by Answer-Sheet Frequency Tables, after Answer-Sheet Score Conversion	25
REFERENCES	63
TABLES.....	S-1 through S-72
FIGURES.....	S-73 through S-88

(A complete listing of Tables and Figures precedes the
ASVAB OMR IOT&E Supplement.)

PREFACE

The completion of this work would not have been possible without the efforts of many persons at the Defense Manpower Data Center (DMDC) and elsewhere. COL Mary Felts and others in the Testing Directorate at the Military Entrance Processing Command provided both leadership and day-to-day assistance in the conversion of that Command's test-scoring system to one that meets state-of-the-art standards of performance. Drs. Michael Kolen and Brad Hanson, American College Testing Program, provided extensive information about operational equating practices and newly developed statistical procedures at ACT. Mr. Paul Foley, Navy Personnel Research and Development Center, provided careful and thoughtful reviews of an earlier draft of the report, and Mr. Joe Guzaitis, DMDC, provided the final editing of this report.

Special recognition must be made of the contributions of Dr. D.R. Divgi, Center for Naval Analyses. This project was one of the first equating studies conducted completely at DMDC. Through his generous and extensive counsel on the data analysis plans and procedures throughout the project, Dr. Divgi provided DMDC with invaluable support by sharing with the authors the benefits of his keen analytic insights and his extensive experience with equating and related statistical issues.

EXECUTIVE SUMMARY

The Armed Services Vocational Aptitude Battery (ASVAB) is a set of tests administered to all applicants for active-duty enlistment in the United States Armed Services. In addition, it is administered to over one million students each year as part of the Department of Defense (DoD) Student Testing Program. The battery yields ten test scores, plus a verbal score which is the sum of scores from two tests and which is included in many analyses and applications. Various combinations of the test scores form composites that are used by DoD and the Services for determining eligibility for enlistment and for classification into military occupations. Composites of test scores are also used for career exploration in the Student Testing Program.

Beginning in June of 1992, the ASVAB operational answer sheets were to be scored by new optical mark readers (OMRs). These OMRs were not capable of scanning the vertical-response spaces on the answer sheets previously used for ASVAB administration. Therefore, a new type of answer sheet -- one using the circular-response format -- was to be implemented concurrently with the new OMRs.

The use of the circular-response type of answer sheet was expected to produce a change in the score scale of at least some of the tests in the ASVAB. Ree and Wegner (1990) conducted a randomized-groups experiment in which one group of military applicants took the ASVAB speed tests, Numerical Operations (NO) and Coding Speed (CS), using an answer sheet with circular-response spaces and another group took the same tests using the vertical-response answer sheet. Using the vertical-response answer sheet resulted in higher mean numbers of correct answers on both tests. On NO, the effect size (mean difference divided by the normative standard deviation) was .36; on CS, the effect size was .11. Although no interpretation was offered for these results, a possible explanation is that, on paper-and-pencil tests of speed, filling a small, circular response space requires more motor control and is, therefore, slower than filling a vertically open-ended response space.

In a replication and extension of this study, Bloxom, McCully, Branch, Waters, Barnes and Gribben (1993) conducted a randomized-groups experiment in which one group of military recruits took all tests of ASVAB 15c using the circular-response answer sheet; another group took the same ASVAB form using the previous answer sheet with vertical-response spaces. Mean number-right scores for the circular-response answer sheet were significantly lower than mean number-right scores for the vertical-response answer sheet on both NO (effect size = .26) and CS (effect size = .09) but not on any of the other tests. Obtaining slightly smaller effect sizes here than in Ree and Wegner (1990) can be attributed to the more restricted range for the military recruit population sampled in Bloxom, et al. (1993) than for the military applicant population sampled in Ree and Wegner (1990).

On the basis of the results obtained in these two studies, it was expected that the circular-response answer sheets to be used operationally by MEPCOM would result in speed test scores which were lower, on the average, than the scores obtained from the use of the vertical-response answer sheets. If this were to occur and if there were not an adjustment in the calibration of the NO and CS score scales, then the scores of military applicants on the occupational composites using speed tests would be reduced; this, in turn, would result in fewer persons being classified as eligible for those occupations than if the vertical-response answer sheets were used.

The present study had three purposes. The first was to assess whether, and by how much, the ASVAB test score scales differ between the circular-response and vertical-response answer sheets. This purpose was addressed for both the speed and non-speed tests. Answer-sheet effects similar to those obtained by Ree and Wegner (1990) and Bloxom, et al. (1993) were expected in this study. Also, as in Bloxom, et al. (1993), answer sheet effects were not expected on the power tests, because the number of items to be answered per unit of allowed time is much smaller than on speed tests -- considerably reducing the influence of variation in the time required to fill in the answer spaces. However, the power tests were investigated here as a precautionary step. If answer-sheet effects were present in the operational administration of the power tests and if the score scales of these tests were not appropriately adjusted to incorporate the effects, then inaccuracies could be introduced into the Armed Forces Qualification Test (AFQT) composite score used for military selection and into the score composites used for classification into military occupational specialties.

The second purpose of this study was to develop any adjustments necessary for long-term operational use of the circular-response answer sheets. Tests that showed answer-sheet effects would require an adjustment in the tables used to convert number-right scores into standard-score equivalents in the norming population, the 1980 18-to-23-year-old Youth Population (Department of Defense, 1982). Most forms of the ASVAB used different conversion tables with the vertical-response answer sheet. It was expected that each of these conversion tables would require adjustment for tests showing answer-sheet effects.

The third purpose of this study was to provide at least a partial check of the effects of any conversion-table adjustments on the distributions of the AFQT composite and the occupational composites used by the individual Military Services. If the test conversion tables were adjusted correctly for the use of circular-response answer sheets, the resulting distributions of composite scores would be quite similar across answer sheets.

The design of this study was to administer the circular-response and vertical-response answer sheets, combined with seven forms of the ASVAB, to randomly equivalent groups of military applicants. Both types of answer sheet were in the format used in the Enlistment Testing Program. The seven ASVAB forms were the six forms (15a, 15b, 16a, 16b, 17a, 17b) in normal operational use during the time of the study, plus ASVAB 15c, which was administered only during the time of the study. This form was equivalent to ASVAB Form 8a, the reference form, which was used to collect the normative data in 1980 (Department of Defense, 1982).

The subjects in this study were applicants for military enlistment who were scheduled for aptitude testing at 63 Military Entrance Processing Stations (MEPS) and associated Mobile Examining Team (MET) sites.

The results of this study indicated that the speed tests of the ASVAB produce lower scores on the new, circular-response answer sheet than on the previously used vertical-response answer sheet; the results indicated no difference between the two answer sheets on the power tests. The direction and magnitude of the effects on speed tests -- and on the score scale calibration needed to correct for these effects -- were generally consistent with results obtained in earlier answer-sheet studies by Ree and Wegner (1990) and Bloxom et al. (1993). Also, the lack of statistically significant answer-sheet effects on power tests was consistent with results obtained by Bloxom et al. (1993).

The results of this study also included conversion tables for operational use of the circular-response answer sheet along with ASVAB forms 11 to 22 in the Enlistment Testing Program and in the DoD Student Testing Program. For ASVAB Forms 20 to 22, the tables were developed for operational use only until the results of an Initial Operational Test and Evaluation (IOT&E) of those forms are available. Those results will include the conversion tables to be implemented when ASVAB Forms 20 to 22 are fully implemented in October, 1993.

INITIAL OPERATIONAL TEST AND EVALUATION OF NEW OPTICAL-MARK-READER ANSWER SHEETS FOR THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY

INTRODUCTION

The Armed Services Vocational Aptitude Battery (ASVAB) is a set of tests administered to all applicants for active-duty enlistment in the United States Armed Services. In addition, it is administered to over one million students each year as part of the Department of Defense (DoD) Student Testing Program. The battery yields ten test scores, plus a verbal score which is the sum of scores from two tests and which is included in many analyses and applications. Various combinations of the test scores form composites that are used by DoD and the Services for determining eligibility for enlistment and classification into military occupations. Composites of test scores are also used for career exploration in the Student Testing Program.

Beginning in June of 1992, the ASVAB operational answer sheets were to be scored by new optical mark readers (OMRs). These OMRs were not capable of scanning the vertical-response spaces on the answer sheets previously used for ASVAB administration (Figure 1). Therefore, a new type of answer sheet -- one using the circular-response format (Figure 2) -- was to be implemented concurrently with the new OMRs.

The use of the circular-response answer sheet was expected to produce a change in the score scale of at least some of the tests of the ASVAB. Ree and Wegner (1990) conducted a randomized-groups experiment in which one group of military applicants took the ASVAB speed tests, Numerical Operations (NO) and Coding Speed (CS), using an answer sheet with circular response spaces and another group took the same tests using the vertical-response answer sheet. Using the vertical-response answer sheet resulted in higher mean numbers of correct answers on both tests. On NO, the effect size (mean difference divided by the normative standard deviation) was .36; on CS, the effect size was .11. Although no interpretation was offered for these results, a possible explanation is that, on paper-and-pencil tests of speed, filling a small, circular response space requires more motor control and is, therefore, slower than filling a vertical-response space.

In a replication and extension of this study, Bloxom, McCully, Branch, Waters, Barnes and Gribben (1993) conducted a randomized-groups experiment in which one group of military recruits took all tests of ASVAB 15c using the circular-response answer sheet; another group took the same ASVAB form using the vertical-response answer sheet. Mean number-right scores for the circular-response answer sheet were significantly lower than mean number-right scores for the vertical-response answer sheet on both NO (effect size = .26) and CS (effect size = .09) but not on any of the other tests. Obtaining slightly smaller effect sizes here than in Ree and Wegner (1990) can be attributed to the more restricted range for the military recruit population sampled in Bloxom, et al. (1993) than for the military applicant population sampled in Ree and Wegner (1990).

On the basis of the results obtained in these two studies, it was expected that the circular-response answer sheets to be used operationally by MEPCOM would result in speed test scores which are lower, on the average, than the scores obtained from the use of the vertical-response answer sheets. If this were to occur and if there were not an adjustment in the calibration of the NO and CS score scales, then the scores of military applicants on the occupational composites using the speed tests would be reduced. This, in turn, would result in fewer persons being classified as eligible for those occupations than if the vertical-response answer sheets were used.

The present study had three purposes. The first was to assess whether, and by how much, the ASVAB test score scales differ between the two answer-sheet formats. This purpose was addressed for both the speed and non-speed tests. Answer-sheet effects similar to those obtained by Ree and Wegner (1990) and Bloxom, et al. (1993) were expected in this study. Also, as in Bloxom, et al. (1993), answer sheet effects were not expected on the power tests, because the number of items to be answered per unit of allowed time is much smaller than on speed tests -- considerably reducing the influence of variation in the time required to fill in the answer spaces. However, the power tests were investigated here as a precautionary step. If answer-sheet effects were present in the operational administration of the power tests and if the score scales of these tests were not appropriately adjusted to incorporate the effects, then inaccuracies could be introduced into the Armed Forces Qualification Test (AFQT) composite score used for military selection and into the composite scores used for classification into military occupational specialties.

The second purpose of this study was to develop any adjustments necessary for long-term operational use of the circular-response answer sheets¹. Tests that showed answer-sheet effects would require an adjustment in the tables used to convert number-right scores into standard-score equivalents in the norming population -- the 1980 18 - 23-year-old Youth Population (Department of Defense, 1982). Most forms of the ASVAB used different conversion tables with the vertical-response answer sheet. It was expected that each of these conversion tables would require adjustment for tests showing answer-sheet effects.

The third purpose of this study was to provide at least a partial check of the effects of any conversion-table adjustments on the distributions of the AFQT composite score and the occupational composite scores used by the individual Military Services. If the test conversion tables were adjusted correctly for the use of circular-response answer sheets, the resulting distributions of composite scores would be quite similar across answer sheets.

Design

The design of this study was to administer the circular-response and vertical-response answer sheets, crossed with seven forms of the ASVAB, to randomly equivalent groups of military applicants. Both types of answer sheet were in the format used in the Enlistment Testing Program. The ASVAB forms used were the six forms (15a, 15b, 16a, 16b, 17a, 17b) in operational use during the time of the study, plus ASVAB 15c, which was administered only during the time of the study. This form is equivalent to ASVAB form 8a (the reference form), which was used to collect the normative data in 1980 (Department of Defense, 1982; Normative means and standard deviations in Table 1.)

¹ Adjustments for short-term operational use were provided in Bloxom et al. (1993) and were implemented during the data collection for this study, with the intent that they would be replaced by adjustments developed from analyses in the present study.

METHOD

Subjects

The subjects in this study were applicants for military enlistment who were scheduled for aptitude testing at 63 Military Entrance Processing Stations (MEPS) and associated Mobile Examining Team (MET) sites no earlier than 24 February nor later than 16 June 1992. At many MEPS, the starting date was delayed by as much as two weeks to allow for necessary adjustments in the sensitivity and contrast settings of the new optical mark readers. At 19 of the MEPS, data collection was terminated after nine weeks because of other special studies. The total number of persons tested for this study was 117,379.

Procedure

The subjects were tested in groups which varied in size according to the number of applicants needing to be tested. The test administrators were employees of a Military Entrance Processing Station or were hired by the Office of Personnel Management to administer the test at Mobile Examining Team sites.

Each subject was provided with the circular- or vertical-response answer sheet, an ASVAB test booklet, two pencils and two pieces of scratch paper. To provide randomly equivalent samples of examinees and frequencies of administration for the two types of answer sheet, both types were to be distributed in a spiraled (alternating) order in each group of examinees. To provide randomly equivalent samples of examinees and frequencies of administration for the seven test forms, the forms were to be distributed in a spiraled order such that each form was administered to every seventh subject in each group of examinees². Furthermore, the cycle of distribution of forms in each session was to begin where it stopped in the test administrator's previous session.

Before the administration of the ASVAB tests, subjects were given standard ASVAB instructions (Department of Defense, 1990) for providing identifying information and signing a Privacy Act statement on the answer sheet. The tests were then administered using the standard ASVAB operational instructions. Following the test administration, the answer sheets were scanned and scored at Military Entrance Processing Stations. The circular-response answer sheets were scanned on a NCS OpScan 07 OMR with a read level (darkness) sensitivity setting of 5 and a discrimination margin (mark contrast) setting of 3³. The vertical-response answer sheets were scanned on a Cognitronics Model 802 OMR.⁴

After the scanning, number-right (raw) scores and identifying information were electronically transmitted to Headquarters, US Military Entrance Processing Command (MEPCOM). At the end of each month, the data were sent by tape to Defense Manpower Data Center (DMDC). Thirty days after testing, the answer sheets for the reference form (ASVAB 15c) and one of the operational forms (ASVAB 17a) were sent to MEPCOM headquarters for scanning to obtain item response data. There, the circular-

² The form administered to a subject that was retesting was constrained to be different from the form used in the initial testing.

³ These were the manufacturer's recommended default settings. To test the reliability of this type of machine using these settings, two machines were used to scan and score the ten ASVAB tests for 235 examinees' answer sheets. Of the 2350 scores obtained, 7 showed discrepancies of 1 point between scanings and 2 showed discrepancies of 2 points. Four of the discrepancies occurred on the NO test; 3 of the discrepancies -- including both discrepancies of 2 points -- occurred on the CS subtest.

⁴ No comparable information was provided on the reliability of the Cognitronix machines.

response answer sheets were also scanned on a NCS OpScan 21 Model 100 OMR with a sensitivity setting of 5 and a contrast setting of 3⁵. The vertical-response answer sheets were scanned on a Cognitronics Model 802 OMR.

RESULTS

Data Quality Control and Editing

In addition to range checks⁶, a sequence of procedures was used for data quality control and editing. Table 2 summarizes the results of applying these procedures. The first procedure eliminated the data of 156 subjects who were tested overseas but whose answer sheets were processed at sites included in the study.

The second procedure for data quality control and editing eliminated 19,292 subjects known to have previously taken an ASVAB. Such subjects were assumed to have score profiles different from subjects in the normative sample (Department of Defense, 1982).

The third procedure eliminated 8,931 subjects tested in sessions in which the number of circular-response answer sheets differed from the number of vertical-response answer sheets by more than 7. These subjects were in three types of sessions:

- 3,097 in sessions using the vertical-response answer sheet only,
- 4,459 in sessions using the circular-response answer sheet only, and
- 1,285 in sessions using both types of answer sheet.

The choice of the threshold of 7 was based on three considerations. The first was an inspection of a table of session-size-by-answer-sheet-difference frequencies; for differences greater than 7 and less than -7, all except 71 of the 624 sessions⁷ used only one type of answer sheet. The second consideration was that, under strict adherence to a spiraled administration of seven test forms in combination with two answer sheets, it is necessary to use two answer sheets in any session with more than 7 subjects. The third consideration was that, under a random distribution of two answer sheets, there is less than a 1% chance of using only one answer sheet in a session with more than seven subjects.

The fourth editing procedure eliminated 10,830 subjects tested at sites which used the vertical-response answer sheet for less than 10% or more than 90% of the subjects across all sessions during the study. The choice of the 10% and 90% thresholds here was based on an inspection of a scatterplot of the 808 test locations, showing the percent of vertical-response answer sheets administered as a function of the number of subjects tested during the study (see Figure 3).

⁵ To test the agreement of this calibration with the calibration obtained with the type of scanner used in the MEPS, both types of machines were used to scan and score the ten ASVAB tests for 235 examinees' answer sheets. Of the 2350 scores, obtained, 10 showed discrepancies of 1 point between scanings, 2 showed discrepancies of 2 points, and 1 showed a discrepancy of 9 points. Six of the discrepancies -- including the discrepancies 2 and 9 points -- occurred on the NO subtest; 3 of the discrepancies occurred on the CS subtest.

⁶ No problems were found in the range checks.

⁷ There was a total of 14,001 test sessions during the data collection. A session was defined as all examinees tested at the same site (MEPS or MET site) in the same day. Although a few sites may have at times administered the test to more than one group of examinees in the same day, analyzing these groups as if they were one group was not thought to interfere with establishing whether the administration of the answer sheets was balanced at that site.

The 78,170 subjects remaining after the editing were distributed across answer sheets and test forms as shown in Table 3.

Equivalence of Groups

During the data collection, both types of answer sheet were to have a spiraled administration in combination with each of the seven test forms. This method of administration was intended to provide randomly equivalent groups of subjects -- those who used the circular-response answer sheet and those who used the vertical-response answer sheet -- for each of the seven test forms. However, if the two types of groups differed on characteristics in addition to the answer sheet used to administer the ASVAB, differences in performance could be attributed to those characteristics as well as to the answer sheet. As a check on the possibility of such confounding, the two types of groups were compared with respect to three background characteristics -- gender, education⁸ and ethnicity⁹ -- which have been found to have some correlation with performance on the ASVAB tests. The comparisons were made in interaction with the ASVAB test form as well as in the aggregate across all forms.

Table 4 shows the results of tests of independence of test form and type of answer sheet and the three background characteristics investigated here. None of the three background characteristics was significantly related to the administration of the two types of answer sheet, either in interaction with the test form or in the aggregate across all forms. Table 5 shows the numbers and proportions of each subgroup -- males, females, non-high-school graduates, high-school graduates, post-secondary students, Caucasians and non-Caucasians -- for the two answer sheets. These results indicated that the groups were sufficiently equivalent to justify proceeding with analyses of answer-sheet effects and with answer-sheet equating analyses.

However, Table 4 shows a statistically significant ($p < .01$) relationship between education and the ASVAB form being administered. Table 6 shows the tendencies for

1. Subjects taking ASVAB 15a/f to have a slight under-representation of post-secondary students,
2. Subjects taking ASVAB 16a/f to have a slight under-representation of non-high-school graduates and over-representation of post-secondary students, and
3. Subjects taking ASVAB 17a/f to have a slight over-representation of non-high-school graduates and under-representation of high-school graduates.

This suggests that, even with properly equated test forms, scores on academic (verbal and quantitative) tests may be slightly depressed for ASVAB 15a/f and ASVAB 17a/f and slightly elevated for ASVAB 16a/f. These results are not problematic for the present study. However, they indicate that the groups taking these three ASVAB forms are not sufficiently equivalent to justify using the data in future studies that may be proposed to check the equatings of these three ASVAB forms to the reference form.

Answer-Sheet Effects: Speed Tests

Answer-sheet effects were analyzed separately for each of the two ASVAB speed tests (NO and CS) and as a group for the other ASVAB tests. Previous results (Ree and Wegner, 1990; Bloxom, et al.

⁸ Three levels of educational certification were considered here: non-high-school diploma, high-school diploma, and post-secondary education.

⁹ Two ethnic categories were used here: Caucasian and non-Caucasian.

1993) suggested that answer-sheet effects could be expected for each of the speed tests; but no previous results were available to indicate that answer-sheet effects could be expected for the other tests. This difference in predictions for the speed and non-speed (power) tests called for statistical tests that differ in their conceptual unit of the Type I error rate (e.g., see Kirk, 1968). Therefore, a conventional Type I error rate ($\alpha = .05$) was used separately for each statistical test of answer-sheet effects on the speed tests, providing more power where there was a prior basis for alternatives to the null hypothesis. For the power tests, the conventional Type I error rate was used for the group of statistical tests of answer-sheet effects on all power tests, providing greater protection against Type I errors where there was no prior basis for alternatives to the null hypothesis.

For each of the two speed tests, the null hypothesis was that the number-right score distribution would be the same for the two types of answer sheet. To test this hypothesis simultaneously for all seven ASVAB forms, a chi-square test statistic was developed separately for each form and then summed across the seven forms -- a procedure that is justified when the statistics for the different forms are obtained from independent samples. The composite statistic was then tested against the tail of the chi-square sampling distribution with degrees of freedom equal to the sum of the degrees of freedom for the chi-squares associated with each of the seven forms.

The chi-square statistic for comparing the two answer-sheet distributions for each of the seven ASVAB forms was based on a procedure developed by Hanson (1992). The procedure uses Holland and Thayer's (1987) polynomial log-linear modelling of frequency distributions to test the null hypothesis of one model fitting both distributions, against the alternative hypothesis of a separate model for each distribution. The first step in this procedure is to use iteratively reweighted least squares (Thisted, 1988; Agresti, 1990) to fit each of the separate distributions using the log-linear model with polynomials of varying degrees. The next step is to determine the degree of polynomial to use for the log-linear fit for each of the two distributions¹⁰. The higher degree of the two fitted polynomials is chosen to be the "comparison test degree" (CTD). Then the CTD-term model is fitted, with parameters of the polynomial constrained to be equal for each of the two distributions. This result is compared with the fit of the CTD-term model with unconstrained parameters for each distribution. The comparison test statistic is a likelihood ratio chi-square, with degrees of freedom equal to the number of distinct parameters used to fit the second model minus the number of distinct parameters used to fit the first model. In this application of the procedure, the test statistic was computed for the two answer sheets separately for each of the seven ASVAB forms; the seven statistics were then summed to obtain the composite test statistic described in the preceding paragraph.

The chi-square obtained from comparing the distributions of the circular-response and vertical-response answer sheets on NO was 3649.14 ($p < .01$ with d.f. = 61)¹¹. The corresponding chi-square for CS was 385.64 ($p < .01$, d.f. = 66)¹². Table 7 shows the mean and standard deviation for each type of answer sheet on each test for each of the seven ASVAB forms; it also shows the answer-sheet effect size, based on the standard deviation of these two tests in the 1980 Youth Population (See Table 1.). As predicted, lower average scores on NO and CS were obtained with the circular-response answer sheets

¹⁰ In this study, the number of terms was based on a backwards elimination decision rule suggested by Haberman (1974; see Hanson 1990a.) The rule is to eliminate high-order polynomial terms until one is found which produces a significant increase in the chi-square measure of fit of the model to the data; that term and all lower-order terms are then retained in the model. The rule was applied liberally here in that a term was considered to make a significant reduction if the increase in the chi-square was significant at $\alpha = .05$, regardless of the number and non-independence of statistical tests. To partially offset the resulting tendency to overfit the data, the maximum number of terms was limited to the smaller of $M/2$ and 10, where M was the number of items in the test.

¹¹ The NO answer-sheet chi-square test statistics for ASVAB forms 15c, 15a, 15b, 16a, 16b, 17a and 17b had 9, 10, 6, 10, 10, 7 and 9 degrees of freedom, respectively.

¹² The CS answer-sheet chi-square test statistics for ASVAB forms 15c, 15a, 15b, 16a, 16b, 17a and 17b had 8, 8, 10, 10, 10, 10 and 10 degrees of freedom, respectively.

than were obtained with the vertical-response answer sheets. Effect sizes ranging from .28 to .33 on NO were of the same order of magnitude as the effect sizes of .36 and .26 obtained by Ree and Wegner (1990) and Bloxom, et al. (1993), respectively. Effect sizes ranging from .05 to .11 on CS were of the same order of magnitude as the effect sizes of .11 and .09 obtained by Ree and Wegner (1990) and Bloxom, et al. (1993), respectively.

Answer-Sheet Effects: Power Tests

Answer-sheet effects were analyzed simultaneously for the set of power tests, because of their lack of statistically significant answer-sheet effects in previous studies. The set of power tests included in the analysis were GS, AR, AS, MK, MC, EI and VE¹³. The simultaneous test of equal distributions consisted of using the same composite chi-square statistic as was employed for analyses of the speed tests. However, to maintain an expected number of Type I errors = .05 for the set of statistical tests associated with the seven power tests, each chi-square was tested with an alpha level of $.05/7 = .00714$.

Table 8 shows the results of the chi-square test of difference between answer-sheet distributions for each of the seven power tests. For none of the tests was the result statistically significant. Table 9 shows the mean and standard deviation for each of the seven power tests on each type of answer sheet for each of the seven ASVAB forms; it also shows the answer-sheet effect size, based on the standard deviation of these two tests in the 1980 Youth Population (See Table 1.).

The answer-sheet effect sizes in Table 9 ranged from -.052 to .026. However, the test median effect sizes were no larger than .016 (.16 standard score points) in absolute value for the seven power-test scores. This was consistent with the non-significance of results provided by the chi-square test and does not indicate the presence of answer-sheet effects on the power tests. Also, the tendency to exhibit slightly higher means for the circular-response answer sheets is opposite to what would be expected from the direction of answer-sheet effects on the speed tests. Thus, whatever indications there were of weak effects on the power tests may be attributable to slight, random pre-existing differences (where they were present) between answer-sheet groups.

Because of the lack of demonstrable answer-sheet effects on the power tests, the remainder of this report addresses only analyses of the two speed tests, NO and CS.

Pooling Distributions for Tests with Answer-Sheet Effects

The sample size used for equating new ASVAB forms to the reference form exceeded 10,000 per form in the IOT&E studies of ASVAB 15/16/17 and ASVAB 18/19. In the present study, the reference-form sample sizes for the vertical-response and circular-response answer sheets were only 5966 and 6295, respectively (Table 3). Therefore, to increase the sample sizes for calibrating (i.e., equating) the circular-response answer sheet to the vertical-response answer sheet, the distributions obtained with the reference form were pooled with the distributions obtained with another ASVAB form. To avoid introducing possible effects of differences between the other form and the reference form, each of the other forms' distributions was statistically compared (Hanson, 1992) with the reference form distribution before deciding which one to pool with the reference form.¹⁴ To maintain an expected number of Type I errors

¹³ The WK and PC test scores are summed to obtain VE scores but are never used alone in the operational composites. Therefore, results obtained for these two tests are needed here only to better understand significant results, if any, that are obtained in analyses of VE.

¹⁴ For each comparison, the null hypothesis was that the same set of parameters of the polynomial fits both the reference form distribution and the other ASVAB form distribution. The alternative hypothesis was that a separate set of weights of the polynomial terms is needed for each distribution. For each hypothesis, an iteratively reweighted least squares procedure (Agresti, 1990; Thisted, 1988) was used for fitting the model to the data (Hanson, 1990b). The CTD (comparison test degree) was chosen in the same way as described earlier for assessing the presence of

= .05 for the set of statistical tests used for comparisons with the reference form, each chi-square was tested with an alpha level of $.05/6 = .00833$.

Tables 10 and 11 show the results of comparing each of the other ASVAB forms with the reference form. The first part of Table 10 shows the results for NO separately for each of the two answer sheets. Statistically significant chi-squares were obtained for ASVAB forms 15a, 16a and 17b on the vertical-response answer sheet and for ASVAB forms 15a and 16a for the circular-response answer sheet, ruling out the possibility of pooling the distributions of forms 15a, 16a or 17b with the reference form distribution. Of the remaining forms, ASVAB form 15b showed relatively small ratios (less than 2.2) of chi-square to the degrees of freedom and similar effect sizes (within .02 of each other; see Table 11) for the two answer-sheets. Therefore, for NO, the distribution of ASVAB form 15b was pooled with the reference form distribution separately for each answer sheet before proceeding with the answer-sheet calibration. The resulting sample sizes (from Table 3) were $5966 + 5769 = 11,735$ for the vertical-response answer sheet and $6295 + 5850 = 12,145$ for the circular-response answer sheet.

The second part of Table 10 shows the results for CS separately for each of the two answer sheets. Statistically significant chi-squares were obtained for ASVAB form 17a on each of the two answer sheets, ruling out consideration of pooling the distributions of form 17a with the reference form distribution. Of the remaining forms, ASVAB form 15a showed relatively small ratios (less than 2.2) of chi-square to the degrees of freedom and similar effect sizes (within .02 of each other; see Table 11) for the two answer-sheets. Therefore, for CS, the distribution of ASVAB form 15a was pooled with the reference form distribution separately for each answer sheet before proceeding with the answer-sheet calibration. The resulting sample sizes (from Table 3) were $5966 + 5716 = 11,682$ for the vertical-response answer sheet and $6295 + 5999 = 12,294$ for the circular-response answer sheet.

Calibration of Tests With Answer Sheet Effects

The use of the circular-response answer sheets to obtain scores on NO and CS for use in military enlistment or for comparison with national norms in the Student Testing Program requires that score scales for these tests be calibrated with an equating transformation, to enable their scores to be placed on the same standard score scale as the reference form, ASVAB 15c. The absence of statistically significant answer-sheet effects for the other tests indicated that no new calibration of their score scales would be required.

Several methods of equating were selected from alternatives reported in the research literature. Appendix A provides a discussion of the approaches which were considered and the reasons for selecting the methods used in these analyses. The methods were: *linear-rescaling*, *linear-identity*, *raw equipercentile*, *quartic-log-linear equipercentile*, and *polynomial-log-linear equipercentile*.

Linear-rescaling equating is the conventional linear procedure for converting number-right scores on the new test forms (here, the circular-response answer sheet) to have the same mean and standard deviation as scores on the reference form (here, the vertical-response answer sheet). (See Angoff, 1971, for details on linear equating.)

Linear-identity equating leaves the scores from the new form unchanged. It is a special case of linear equating, where equal means and standard deviations are assumed.

answer-sheet effects. The test statistic was a likelihood ratio chi-square, with degrees of freedom equal to the difference in the number of distinct parameters required under the null and alternative hypotheses.

Both the linear-rescaling and linear-identity equating methods were included for comparative purposes, but neither one was used. Divgi (1988a) showed that, for the sample size and population used in this study, linear equatings do not replicate as well as equipercentile equatings.

Equipercentile equatings were obtained from each of several estimates of the test cumulative frequency distributions.

Raw equipercentile equating is an equipercentile equating obtained from the unsmoothed frequency distributions; this was obtained for reference only but was not used because of its lack of smoothness, its large number of parameters, and its consequently greater sampling variability.

Quartic log-linear equating is an equipercentile equating obtained from the fourth-order-polynomial, log-linear smoothing¹⁵ of each frequency distribution; the fourth-order polynomial was considered here, because the first four terms of the polynomial were statistically significant in fitting the log of the frequency distributions for most forms of the tests in recruit samples for ASVAB 15/16/17 (See Appendix B.)

Polynomial log-linear equating is an equipercentile equating obtained from a log-linear smoothing that includes all polynomial terms up through the highest-order statistically significant term (less than the eleventh term). The number of terms is based on a decision rule suggested by Haberman (See Holland and Thayer, 1987), with upper and lower bounds placed on the number of terms in the polynomial. The upper bound is the smaller of $M/2$ and 10, where M is the number of items in the test; the lower bound is four, the same as the quartic polynomial.

Table 13 provides the resulting number of polynomial log-linear terms selected for each of the distributions used for equating. Figures 4 and 5 show, for NO and CS, respectively, the unsmoothed, the quartic-log-linear-smoothed, and the polynomial-log-linear-smoothed distributions used in selecting an equating of the circular-response answer sheet to the vertical-response answer sheet.

Prior to each equipercentile equating, two modifications were made in the estimates of the cumulative distribution functions. First, the extreme lower tail of each distribution was smoothed in a way that resulted in an identity equating at the bottom of the number-right score scale. The major concern was that equipercentile equating is unstable where the score frequencies are small. The reason for making the lower end of the equating result in an identity equating instead of some other function was that equipercentile equating provides no alternative to assuming parallel measurement where the test contents are parallel, score levels are below the level expected from random responding, and the score frequencies are small. The mechanism for making the lower end of the equating result in an identity equating here was to substitute a power function (see Appendix C.) for the estimated cumulative distribution below the .5th percentile. The parameters of the function were chosen to preserve both the estimated frequency and cumulative distribution functions where the power function was attached. Such a procedure results in a relatively smooth equating function and does not affect the equating at scores above the .5th percentile. This mechanism is a modification of one used by Kolen and Brennan (1990); those authors used a linear function with a zero intercept instead of the more general power function, resulting in an equating that may not be very smooth at the .5th percentile if the test is short.¹⁶

¹⁵ This consisted of fitting a polynomial to the logarithm of the frequency distribution (Linson, 1990b).

¹⁶ With the linear smoothing below the .5th percentile, the slope of the equating function is discontinuous at the .5th percentile if the equating function above that percentile is either (a) less than an identity equating and having a slope greater than an identity equating, or (b) greater than an identity equating and having a slope less than an identity equating.

The second modification of the cumulative distributions prior to equipercentile equating was to add .5 to the number-right score associated with each cumulative frequency and to create a new origin ($X = -.5$, $F(X) = .0$) at the lower end of the function. This was done so that the cumulative distribution could have the conventional interpretation as a continuous-score distribution that is linear from .5 below each number-right score to .5 above each number-right score (Kolen and Brennan, 1990).

After the distributions were smoothed and the alternative equipercentile equatings were computed, the final step was to choose between the quartic and polynomial log-linear equatings. The objective was to use the equating with fewer parameters, i.e., the quartic equating, if it did not result in an unacceptable equating of the new form to the reference form. Specifically, this step required comparing the two equatings in the score metric (i.e., in terms of differences between their score scales) and in the frequency metric (i.e., in terms of differences between distributions of the equated scores). These comparisons were measured both in terms of the algebraic distance between functions (root-mean-squared difference) and in terms of the practical impact of those differences (i.e., percent of cases affected). Appendix D provides further details on these criteria and indices and lists the heuristics which were used for selecting an equating.

Equatings Selected from Application of Heuristics. Table 12 summarizes the results used to compare the alternative equatings in the score metric and in the frequency metric. The first section of the table provides the score-metric root-mean-squared difference (see Appendix D) between each smooth equating and the raw equipercentile equating. For both NO and CS, the results indicated that the polynomial log-linear equating provided the best fit to the raw equipercentile equating. The second section of the table provides the frequency-metric root-mean-squared difference (between the cumulative distributions of the equated scores and the cumulative distribution of the vertical-response answer sheet). For both NO and CS, the quartic log-linear equating provided no improvement over the polynomial log-linear equating. Thus, using heuristics (1) and (2) in Appendix D indicated that the polynomial log-linear equating provided the best fit to the data for both tests.

The second section of Table 12 ("Impact of Difference") shows the practical impact of differences between alternative equatings. The third section provides the percent of cases for which the quartic log-linear equating differed from the polynomial log-linear equating by more than .5 standard score points. For both NO and CS, the quartic log-linear equating appeared promising in that it had fewer parameters than the polynomial log-linear equating and differed from it by .5 points for fewer than 10% of the cases. The fourth section of the table provides the percent of cases for which the cumulative distributions from the quartic log-linear and polynomial log-linear equatings differed from the reference-form distribution by more than .01. For CS, the quartic log-linear equating provided a cumulative distribution differing from the reference distribution by more than .01 for fewer than 10% of the cases. However, for NO, only the polynomial log-linear equating satisfied this criterion of fit to the reference distribution. Thus, for CS, using heuristic (4) in Appendix D resulted in the selection of the quartic log-linear equating, because it has the fewest parameters without substantially reducing the fit to the data. For NO, the polynomial log-linear equating was selected.

The graphs in Figures 6a and 6b (for NO) and 7a and 7b (for CS) were inspected to provide a check on the answer-sheet equatings selected for use with these two tests. Figure 6a shows standard score differences between linear identity equating and linear-rescaling, raw equipercentile and polynomial log-linear equatings. The differences are plotted as a function of the number-right score on the circular-

response answer sheet for the sample of applicants receiving that answer sheet¹⁷. Figure 6b shows differences between the cumulative distribution functions of scores on the vertical-response answer sheet and quartic-log-linear and polynomial-log-linear equated scores on the circular-response answer sheet. The differences are plotted as a function of the number-right score on the vertical-response answer sheet for the sample of applicants receiving that answer sheet¹⁸. Information in a similar format is provided for the CS test in Figures 7a and 7b. The results in these figures indicated that the selected equatings would not result in systematic departures from the score scale or from the distribution of the vertical-response answer sheet for either NO or CS.

Effect of ASVAB Form on Answer-Sheet Calibration

The NO and CS answer-sheet calibrations developed in the preceding section are intended to be operational with a number of different ASVAB forms -- ASVAB 15/16/17, ASVAB 18/19, and ASVAB 20/21/22. Such a general application assumes that the calibrations (1) display invariance over the ASVAB test forms on which they were developed and (2) adjust for answer-sheet effects on ASVAB forms other than the ones on which they were developed. Two analyses were conducted to provide a partial check of adherence to these assumptions.

In the first analysis, the selected NO and CS calibrations developed from the pooled reference-form and operational-form distributions were compared with calibrations developed from the reference-form (ASVAB 15c) distributions only. For NO, Figure 8a shows the standard-score contrast of each of these two calibrations with a linear-identity equating.¹⁹ Figure 8b shows the comparative results for CS.²⁰ Over the range of raw scores where the greatest density of data is found, each of the figures shows less than half of a standard-score difference between the calibration based on the pooled distributions and the calibration based on the reference form only. This size of a difference is within the range of an effect not thought to be of practical importance.²¹

In the second analysis, the calibrations developed with the pooled distributions were applied to NO and CS scores from the circular-response answer sheet on each ASVAB form. The resulting adjusted score distributions for the circular-response answer sheet were then compared with the score distributions for the vertical-response answer sheet. Table 14 provides the mean, standard deviation, skewness and kurtosis thus obtained for NO and CS on each ASVAB form. Table 15 shows the NO and CS answer-sheet effect-sizes for each ASVAB form before and after using the answer-sheet calibration to adjust scores on the circular-response answer sheet; Figure 9 shows these results in the context of differences between answer sheets across ASVAB forms for other tests. For NO, an inspection of these results shows no systematic pattern of answer-sheet effect remaining after application of the calibration. For CS, the results show a slight answer-sheet effect remaining for those ASVAB forms not used in the calibration. However, the magnitude of the effect does not exceed one-half standard score point on the average. Like

¹⁷ The means and standard deviations in Table 13 were used to compute the linear-rescaling equatings. The means and standard deviations from the Youth Population (Table 1) were used to convert the equated scores to the standard scores being contrasted in Figures 6 and 7.

¹⁸ Linear interpolation was used to obtain the cumulative distributions of equated scores at these points. None of the cumulative distributions used in these contrasts was smoothed.

¹⁹ The NO calibration based on the reference-form-only distributions used polynomial log-linear equating, the method selected for NO calibration with the pooled distributions. The NO mean and standard deviation from the Youth Population norms (see Table 1) were used to convert the equated scores to standard scores.

²⁰ The CS calibration based on the reference-form-only distributions used quartic log-linear equating, the method selected for the CS calibration with the pooled distributions.

²¹ "In our view, differences that are smaller than ± 0.5 on the standard score scale can and should be ignored, since they are no larger than rounding error, whereas larger differences require interform adjustment." Letter from Defense Advisory Committee for Military Personnel Testing, to Dr. W.S. Sellman, September 10, 1988.

the results described in the preceding paragraph, this is within the range of an effect not thought to be of practical importance.

Comparison with Previous Answer-Sheet Calibrations

Prior to developing the NO and CS answer-sheet calibrations in this study, extensive data editing was required to obtain equivalent groups for the two answer sheets. Even though the editing was not based on factors dependent on the test performance of the examinees, the editing could have (a) introduced new biases into the sampling and/or (b) inadequately compensated for the initial non-equivalence of groups. As a result, the calibrations could be highly procedure-dependent or sample-dependent. To provide a partial check on these dependencies, each of the calibrations was compared with calibrations obtained in two earlier studies. In one study (Wegner and Ree, 1985), the circular-response answer-sheet used in the NORC norming of ASVAB (Department of Defense, 1982) was calibrated to the vertical-response answer sheet used in this study; the examinees in that study were military applicants being tested operationally as part of their enlistment processing. In the other study (Bloxom, et al. 1993), the two answer sheets used in the calibration were the same as those used in the present study; but the examinees in that study were military recruits being tested non-operationally during basic training.

Figure 10a shows comparative results for NO from the present study, from Wegner and Ree (1985) and from Bloxom, et al. (1993). In each case, the results are shown as a standard score contrast with a linear-identity equating.²² The calibrations from the present study and from Bloxom, et al. (1993) are very similar over the range from 27 to 50, where the greatest density of data is found. Differences between these calibrations in the lower tail of the distribution are what would be expected from greater sampling variability where the data are sparse. The calibrations from the present study and from Wegner and Ree (1985) show discrepancies of as much as two standard score points for scores as high as 40. However, a precise interpretation of these discrepancies is difficult because of differences in the equating procedures used in the two studies. Specifically, Wegner and Ree (1986) used an unweighted least-squares quadratic smoothing of the raw equating function, with constraints to maintain monotonicity and to keep equated scores in the raw-score range. Unless the true equating function satisfies this functional form, it is unlikely that both studies would produce equivalent results. In spite of this, it can be seen that the calibrations in the two studies are in the same direction and of the same general magnitude for much of the score range.

Figure 10b shows comparative results for CS from the present study, from Wegner and Ree (1985) and from Bloxom, et al. (1993). In each case, the results are shown as a standard-score contrast with a linear-identity equating.²³ The calibrations from all three studies are very similar where much of the greatest density of data is found. However, the present study and Bloxom, et al. (1993) show differences greater than half of a standard score point in the neighborhood of raw scores of 65-70. The inflections in the functions in Figure 10b suggest that these differences could be due, in part, to the selection of a quartic-polynomial smoothing of CS distributions in the present study; relatively flexible higher-order polynomial smoothings of distributions were selected for the CS calibration in Bloxom, et al. (1993). The calibrations from the present study and from Wegner and Ree (1985) show discrepancies of as much as one and a half standard score points for scores at the extreme top of the scale. This can be attributed, in part, to the use of a linear calibration by Wegner and Ree (1985). Also, needing to use the NORC circular-response answer-sheet layout that was less isomorphic to the item layout in ASVAB test

²² The calibration from Wegner and Ree (1985) is shown as a step function because the calibration was reported only in its rounded, number-right metric and could not be reconstructed in more detail from the information provided in the published report.

²³ The calibration from Wegner and Ree (1985) was reported as a step function but is shown here as a continuous function, because the calibration was a linear equating that could be reconstructed from the information provided in the technical report.

booklets may have produced more of a score-scale adjustment in Wegner and Ree (1985) than in Bloxom, et al. (1993) and in the present study.

Conversion Table for ASVAB 8f/13h/15h/18h

Operational use of the circular-response answer sheets requires that number-right scores on each test are converted to standard score equivalents in the metric of the 1980 Youth Population. For those tests showing no answer-sheet effect, the conversion tables are the same as the tables previously used to convert number-right scores from the vertical-response answer sheet (Department of Defense, 1989). However, the tests showing answer-sheet effects -- NO and CS -- require new conversion tables.

The standard score equivalents in Tables 16 and 17 provide the information required for the answer-sheet conversion tables for NO and CS, respectively, on ASVAB 15c and equivalent forms. For the selected equipercentile equatings -- polynomial log-linear on NO and quartic log-linear on CS -- the standard score equivalents were rounded to the nearest integer and truncated at 20. The rounding followed the convention of rounding up if the decimal remainder is greater than or equal to .5 and rounding down otherwise. The truncation followed the ASVAB convention of limiting the standard score scale to values between and including 20 and 80 (Maier and Sims, 1986). The resulting conversion table for use of the circular-response answer sheet with ASVAB 15c in the IOT&E and with 18c in the Student Testing Program is given in Table 18. The values for NO and CS are from the present study; the values for the other tests are the same as in the ASVAB 15c conversion table (Department of Defense, 1989) that was used with the vertical-response answer sheet. To avoid confusion with the conversion tables used for ASVAB 8a/13c/15c/18c with the vertical-response answer sheet, this table is labelled for use with ASVAB forms 8f/13h/15h/18h, even though the test booklet contains the same items as ASVAB 8a/13c/15c/18c. Table 19 shows the correspondence of all ASVAB booklets and their form designations to be used with the vertical-response and circular-response answer sheets (Defense Manpower Data Center, 1990).

Conversion Table for ASVAB 8g/9f/9g/10f/10g/14f/14g/14h

ASVAB Forms 8b, 9a, 9b, 10a and 10b have occasionally been used for special projects and for In-Service Testing. Also, ASVAB Forms 14a, 14b and 14c were recently administered as part of the DoD Student Testing Program. Even though no plans are being made for their continued use, one or more of these forms may be utilized in unexpected situations. USMEPCOM has begun to use the new, circular-response-format answer sheets in all of its Military Entrance Processing Stations. Therefore, answer-sheet conversion tables are provided for ASVAB 8/9/10/14.

One conversion table was used for all ASVAB 8/9/10/14 forms with the vertical-response answer sheet. This table was the same as the one used for ASVAB 15c. Therefore, the table to be used for ASVAB forms 8/9/10/14 with the circular-response answer sheet is the same as the one shown in Table 18 for ASVAB 15c and equivalent forms. To avoid confusion with the conversion tables used with the vertical-response answer sheet, this table is labelled for use with ASVAB 8g, 9f, 9g, 10f, 10g, 14f, 14g, and 14h (Defense Manpower Data Center, 1990).

Conversion Tables for ASVAB 11f/g to 13 f/g and 15f/g to 19f/g

ASVAB Forms 11a, 11b, 12a, 12b, 13a, and 13b are occasionally used for special-purpose testing, e.g., for In-Service testing. ASVAB Forms 15a, 15b, 16a, 16b, 17a and 17b are currently administered in the Enlistment Testing Program. ASVAB Forms 18a, 18b, 19a and 19b are currently administered as part of the DoD Student Testing Program. With the vertical-response answer sheet, number-right scores were converted to standard-score equivalents by using conversion tables based on IOT&E equatings of these forms to the reference form, ASVAB 8a (relabeled either 13c, 15c, or 18c for various equatings). To use these test forms with the circular-response answer sheet, these IOT&E equatings of NO and CS had to be linked to the answer-sheet calibrations. The resulting conversion tables were then to replace the previous conversion tables, which were based on the IOT&E equatings alone.

The procedure for linking the test-form equatings to the answer-sheet calibrations had two steps. The first step for each of the two tests was to use the selected answer-sheet calibration to convert integer number-right scores to equivalent (fractional number-right) scores on the vertical-response answer sheet, as shown in the fourth column of Tables 16 and 17 for NO and CS, respectively. The second step used linear equatings (see Table 21) from IOT&E studies of ASVAB 11/12/13 (Andberg, Stillwell, Prestwood and Welsh, 1988) and ASVAB 15/16/17 to convert the fractional number-right from Tables 16 and 17 to the equivalent fractional number-right on ASVAB 15c. The second step for ASVAB 18/19 was to use linear interpolation of the equipercentile equatings from the IOT&E (Bloxom and McCully, 1992, Appendix F) to convert the fractional number-right from Tables 16 and 17 to the equivalent fractional number-right on ASVAB 15c. A summary of these two linking steps is given in Table 20.

Following the linking, the 1980 Youth Population means and standard deviations (Table 1) were used to convert the 15c-equivalent fractional number-right score to the standard-score metric. The resulting fractional standard-score equivalents for each ASVAB form are given in Tables 22 and 23 (for NO) and Tables 24 and 25 (for CS).²⁴ Then, the standard-score equivalents in Tables 22-25 were rounded and truncated at 20. The resulting integers provided the values for NO and CS, respectively, in Tables 26-37. As is indicated in Table 19, the latter tables are for use with ASVAB forms 11f, 11g, 12f, 12g, 13f, 13g, 15f, 15g, 16f, 16g, 17f, 17g, 18f, 18g, 19f and 19g.

Conversion Tables for ASVAB Forms 20a/b to 22a/b

ASVAB Forms 20a, 20b, 21a, 21b, 22a, and 22b will replace ASVAB Forms 15/16/17 in the Enlistment Testing Program in October, 1993. Unlike the previous ASVAB forms, they were equated to the reference form 15c in a study which used the circular-response answer sheet alone. Because of this, the two-step linking procedure was different from that for other test forms. First, the equatings obtained from the operational calibration of ASVAB 20/21/22 were employed to convert the integer number-right score to the 15c-equivalent fractional number-right; these equatings are in Thomasson and Bloxom (1992, Appendix E²⁵). Second, linear interpolation of the equatings selected for NO (Table 16) and CS (Table 17) were used to convert the 15c-equivalent fractional number-right scores on the circular-response answer sheet to fractional number-right-equivalent scores on the vertical-response answer sheet.

²⁴ Note that, in some cases, standard score conversions in Tables 22 to 25 are provided for combinations of ASVAB forms instead of for only single forms. This has been done where forms were combined for equating purposes in the IOT&E studies, due to duplicate items and/or very similar score distributions.

²⁵ This reference provides the equated fractional number-right only after conversion to 1980-metric standard scores.

The remaining steps in the development of conversion tables were the same as for the other test forms. The 1980 Youth Population means and standard deviations (Table 1) were used to convert the fractional number-right score to the standard score metric; the resulting standard score equivalents for each ASVAB form are given in Table 23 (for NO) and Table 25 (for CS). Then, the standard score equivalents in Tables 24 and 25 were rounded and truncated at 20. The resulting integers provided the values for NO and CS in Tables 38 to 43. As indicated in Table 19, these conversion tables are for use with ASVAB forms 20a, 20b, 21a, 21b, 22a, and 22b and the circular-response answer sheets.

Distributions of Composites of Converted Test Scores

ASVAB test standard scores are used in various combinations to determine qualification for military enlistment and for classification into occupational specialties. Table 44 shows the test combinations for the Armed Forces Qualification Test (AFQT) and for the Services' occupational specialty score composites (Department of Defense, 1989). In practice, the AFQT and Air Force composites of test standard scores are transformed to percentile scores. The Army and Marine Corps composites are transformed to standard scores with a mean of 100 and a standard deviation of 20; and the Navy composites are used without a further transformation of the score scale. Minimum cutting scores on the composites are then used to place applicants and recruits into categories to determine eligibility for selection and classification.

In an earlier section of this report, the impact of using the equated circular-response answer sheet was described in comparisons of distributions of equated test scores with distributions of scores on the vertical-response answer sheet. To further evaluate the impact of using the equated circular-response answer sheets, the conversions in Table 18 were applied to all test scores obtained from administering the reference form, ASVAB 15c, with the circular-response answer sheet in the present study. Also, the current conversion table for ASVAB 15c (Department of Defense, 1989) was applied to all test scores obtained from administering the reference form with the vertical-response answer sheet in the present study. Then, the resulting scores were used to compute the composite scores listed in Table 44. Finally, the cutting scores shown in Table 45 and the distributions of the composites were used to assess the number of subjects in each composite score category for each type of answer sheet.

The number of cases in each composite category for each type of answer sheet was analyzed in a Pearson chi-square test of an " $m \times 2$ " frequency table, where m was the number of categories for the composite. (See cross-tabulations of frequencies and percentages in Appendix E.) The resulting chi-squares and degrees of freedom are shown in Table 46.

An inspection of Table 46 shows that five of the nine composite scores using NO or CS -- tests for which conversion tables differed across answer sheets -- had chi-squares greater than their degrees of freedom. The smallest probability for these nine chi-squares -- .088 for the Navy BC composite -- approached but did not reach statistical significance at the .05 level. With the possible exception of the result for the BC composite, these results suggest that the circular-response answer-sheet conversion tables for NO and CS effectively removed the differences between the answer sheets for these tests in the sample used in this study. The results for the BC composite in Appendix E indicate a tendency for slightly higher scores on the circular-response answer sheet than on the vertical-response answer sheet, a result that is consistent with the pattern for the power tests (Table 9) and may, therefore, be arising from patterns in the power tests (VE and MK) in the BC composite. As noted on pages 11-12, this pattern is not consistent with the expected direction of answer-sheet effects and may be attributable to slight pre-existing differences between answer-sheet groups.

DISCUSSION

The results of this study indicated that the speed tests of the ASVAB produce lower scores on the new, circular-response answer sheet than on the previously used vertical-response answer sheet. The results indicated no difference between the two answer sheets on the power tests. The direction and magnitude of the effects on speed tests -- and on the score scale calibration needed to correct for these effects -- were generally consistent with results obtained in earlier answer-sheet studies by Ree and Wegner (1990) and Bloxom et al. (1993). Also, the lack of statistically significant answer-sheet effects on power tests was consistent with results obtained by Bloxom et al. (1993).

The results of this study also included conversion tables for operational use of the circular-response answer sheet along with ASVAB forms 11 to 22 in the Enlistment Testing Program and in the DoD Student Testing Program. For ASVAB Forms 20 to 22, the tables were developed for operational use only until the results of an Initial Operational Test and Evaluation (IOT&E) of those forms are available. At that time, the tables provided here will be replaced by tables to be used when those forms are implemented in October, 1993.

Although the conversion tables provided in this study are intended to fulfill an operational requirement for the use of the circular-response answer sheets, further studies are required to more completely assess the accuracy of the tables. One such study would concern the extent to which the conversion tables provided by this study could become incorrect over time if examinees are coached on effective strategies for improving their scores on the circular-response answer sheet. The vertical-response answer sheet was subject to score inflation on speed tests if military applicants filled response spaces more lightly and quickly than was done by examinees when the tests were normed. Over the first several months of use of the circular-response answer sheet, it may be discovered that examinees need not completely fill in the circular response spaces or keep pencil marks strictly within the spaces in order to obtain credit for correct answers. Therefore, it will be important to devise methods of monitoring "light-touch" response response patterns on the circular-response answer sheet. Where changes are detected over time, it will then be important to assess (a) the sensitivity of the optical mark readers to these new response patterns and (b) the potential impact of the patterns on the conversion tables provided in this report.

SUMMARY AND CONCLUSIONS

In 1992, the United States Military Entrance Processing Command (USMEPCOM) began using new optical mark readers to scan answer sheets for the Armed Services Vocational Aptitude Battery (ASVAB). This necessitated using answer sheets which are different from those used previously. The results of this study indicated that the speed tests of the ASVAB produce lower scores on the new answer sheet (with a circular-response format) than on the previous answer sheet (with a vertical-response format). The direction and magnitude of this effect -- as well as the calibration needed to correct for the effect -- were generally consistent with results obtained earlier by Ree and Wegner (1990) between the vertical-response answer sheets and an earlier version of the circular-response answer sheet which was used to norm the ASVAB. Also, the results obtained here for both the speed and power tests were generally consistent with the results obtained earlier by Bloxom et al. (1993) for the same two types of answer sheets as were used in this study.

Although the results of this study were generally consistent with previous studies of answer-sheet effects, the conversion tables provided here can be assumed to be more precise than the tables previously

available. The previous tables for the circular-response answer sheet were based on a calibration study (Bloxxom, et al. 1993) which used only a moderate number of subjects -- 2500 per group -- and samples from a highly selected population --military recruits. The tables provided here were based on a calibration which used a very large number of subjects -- over 10,000 per group -- and samples which are representative of the present distribution of applicants for Military Service.

Although the conversion tables here were developed for operational use with ASVAB forms 11 through 22, it was assumed that adjustments would be made in the tables for ASVAB Forms 20, 21 and 22 subsequent to the equating analyses from the Initial Operational Test and Evaluation (IOT&E) of those forms. Unlike the previous equating analyses for those forms, analyses of the IOT&E data will be based on samples which are much larger and which are representative of the present distribution of applicants for Military Service.

APPENDIXES

Appendix A

Alternative Methods of Equating

Several approaches can be considered for calibrating tests on the circular-response answer sheets so that their scores will be on the same score scale as on the vertical-response answer sheet. The primary approaches considered here are the following methods of equating:

- random-groups linear equating
- random-groups equipercentile equating
- matched-groups linear equating, and
- matched-groups equipercentile equating

True-score equatings (e.g., Lord and Wingersky, 1983) are not considered here, because of the lack of research and experience related to equating from an item response theory for speed tests. Summary descriptions of these five approaches are provided in Angoff (1971), Braun and Holland (1982), Peterson, Kolen and Hoover (1989), Kolen and Brennan (1990) and Dorans (1990).

Even though a randomly-equivalent groups design is typically used for ASVAB equating data collection, matched-groups equating methods can be considered when the subjects are military recruits. These methods offer the potential for controlling for whatever random differences occur between groups. The matching variable in this case would be the pre-enlistment ASVAB score on the test being calibrated. Any association of this score with the score on the test being calibrated could potentially be exploited to improve the precision of the calibration.

In spite of this theoretical advantage of matched-groups equating, the approach is not considered further here. The main concern is that the approach has not been demonstrated to improve the precision of the calibration in the present context. What is distinctive about this context is that the matching variable (pre-enlistment ASVAB) is a measure taken, in some cases, two years prior to the test being calibrated and under different motivational conditions. This is in contrast to conventional matched-groups equating in which the matching variable is a measure taken in close temporal proximity to, and under similar motivational conditions as, the test being calibrated. Systematic influences between the measurement of the matching variable and the test being calibrated include substantial selection (50% for military enlistment), learning (during the final year of secondary education) and motivational changes (from operational to non-operational conditions of administration). This, plus the highly skewed -- in the case of NO, monotonic -- distributions of ASVAB tests, make it difficult to assume that the results of previous studies of matched-groups equating (e.g., see Dorans [Ed.], 1990) generalize to the present context. However, there is a need for ASVAB studies of matched-groups equating -- e.g., using the evaluation design employed by Divgi (1988b) -- so that any improvements obtainable by this approach could be exploited in future calibrations.

Random-groups linear equating and random-groups equipercentile equating are considered here, because of prior experience in the use of these approaches for ASVAB equating and answer-sheet calibration. Both approaches were used in the answer-sheet calibration study by Ree and Wegner (1990). Divgi (1988b) compared linear and equipercentile equatings from recruit samples and, for each approach,

found some tests in which the linear approach provided the best prediction of equating in large samples of military applicants. However, Divgi (1988a) also found that for sample sizes closer to those used in an IOT&E data collection, linear equatings do not replicate as well as equipercentile equatings.

Equipercentile equating usually employs some form of smoothing either the test distributions or the equating function, in an effort to reduce the sampling variance of the equating function. Three criteria guide the choice among alternative smoothing methods for use in equipercentile equating.

1. The *first* criterion is that the method be symmetric, so that the equating can serve as a basis for converting scores on either test form to the score scale provided by the other test form; this is a criterion that has been advocated by Lord (1980), Peterson, Kolen and Hoover (1989) and Dorans (1990) in support of the idea of interchangeability of equated test forms.
2. The *second* criterion is that the method of estimating score distributions use a statistical measure of fit to the distributions of scores on the two test forms.
3. The *third* criterion is that there be a sequence of distributional models, differing primarily in their number of parameters; the objective here is to choose the model with the smallest number of parameters to reduce sampling variability in the estimator of the equating function.

Equipercentile equating based on log-linear-smoothed distributions satisfies these three criteria. The method results in symmetric equating by using a flexible functional form to independently smooth the distribution of scores obtained from each test form. Then, the smoothed distributions are used to obtain an equipercentile equating of scores on the new ASVAB form to the score scale on the reference form. This approach has been termed pre-smoothing (Fairbank, 1987).

By basing the equating on log-linear-smoothed distributions, the method provides a statistical measure of fit to the distributions. The smoothing employs the method of iteratively reweighted least squares to fit polynomials to the logarithm of the frequency distributions, in a manner suggested by Thisted (1988) and Agresti (1990). This method is implemented by a computer program (Hanson, 1990b), which provides a chi-square fit statistic for polynomials with as many as ten terms.

By basing alternative equatings on a sequence of log-linear-smoothed distributions, it is possible to select an equating obtained from the smallest number of parameters without jeopardizing the fit of the model to the data. The procedure is to obtain as many terms in the polynomial as are necessary to provide a good statistical fit to the non-null bins of a distribution. Sampling variability is then reduced by excluding all terms with a power higher than ten and all other high-order terms that do not improve the fit. The method has an added advantage of exactly preserving as many moments of a distribution as there are powers of x in the polynomial. Although equipercentile equating is not defined in terms of preserving the moments of a distribution, knowing that the first several moments are preserved provides another indicator of the extent to which the distribution is preserved.

Appendix B

Log-linear Smoothing of ASVAB Test Distributions from the Operational Calibration of ASVAB 15, 16, and 17

Lower/Upper Bounds (Up To 10) of
Polynomial Degree Producing Statistically Significant*
Improvement in Likelihood-Ratio Chi-Square

<u>ASVAB Form:</u>	<u>15a</u>	<u>15b</u>	<u>15c</u>	<u>16a</u>	<u>16b</u>	<u>17a</u>	<u>17b</u>
<u>Test</u>							
GS	6/6	6/6	2/6	2/4	2/8	4/4	6/9
AR	4/4	4/10	4/4	3/8	4/6	4/4	4/4
WK	5/8	6/6	3/10	4/4	3/6	2/10	3/8
PC	5/5	6/9	4/4	4/10	4/7	4/4	5/5
NO	4/9	4/6	5/8	4/8	4/9	4/8	4/8
CS	5/5	5/5	5/7	5/7	5/5	5/10	5/7
AS	5/5	4/4	6/6	4/4	6/6	4/4	4/6
MK	4/4	4/7	4/10	4/8	4/8	5/5	4/4
MC	2/4	2/9	4/7	2/4	2/4	2/5	2/4
EI	5/5	5/5	2/4	4/4	4/4	4/10	4/4
VE	8/8	6/6	4/6	4/6	6/10	2/6	4/4

* Alpha = .05 with d.f. = 1.

Appendix C

Estimation of the Lower Tail of the Test Cumulative Distribution for Equipercntile Equating

Let F_i be the proportion of the population at or below test score i , $i=0, \dots, m$, where m is the number of items in the test.

Let f_i be the proportion of a population of subjects at test score i , or $f_i = F_i - F_{i-1}$

If $F_0 \leq .005$, let u in $0 < u < m$ be the lowest (integer) score such that $F_u > .005$.

Then let the estimated $F_i = [(i+1)/(u+1)]^c F_u$, (1)

where c is chosen to preserve the slope of F_i over the interval $(u-1, u)$.

Then $c = \ln [1 - f_u/F_u] / \ln [u/(u+1)]$. (2)

Proof:

If $i = u$, then $[(i+1)/(u+1)] = 1$ and $F_i = F_u$ in (1).

If $i = u$, then, from (1), $F_{u-1} = [u/(u+1)]^c F_u$

$$\begin{aligned} \text{and } f_u &= F_u - F_{u-1} = F_u - [u/(u+1)]^c F_u \\ &= F_u \{1 - [u/(u+1)]^c\}. \end{aligned}$$

Dividing by F_u , transposing terms, and taking logarithms yields

$$c \ln [u/(u+1)] = \ln [1 - f_u/F_u].$$

Dividing by $\ln [u/(u+1)]$ yields (2).

Appendix D

Choosing among Alternative Equatings

In their discussion of evaluating an observed-score equating, Braun and Holland (1982) stated that, if there exists a population for which the reference-form (here, the vertical-response answer sheet) distribution differs from the equated new-form (here, the circular-response answer sheet) distribution, then the forms have not been equated. This implies two metrics in which equatings can be compared. The first is the score metric, in which the (cumulative) frequency is held constant and equated scores are compared. This is a type of comparison often used in a close study of alternative equatings, e.g., to see how different a linear equating is from an equipercentile equating. If various equatings provide similar equated scores, they are considered equally acceptable from the perspective of the examinee.

The second metric implied by Braun and Holland is the frequency metric, in which the score is held constant -- e.g., at integer values on the reference form -- and the cumulative distributions of the equated scores and reference form scores are compared. This is a type of comparison used to assess whether implementing an equated new form will change the score distributions, e.g., to see if there will be a change in the percent of persons qualifying for employment. If various equatings have no effect on the score distributions, they are considered equally acceptable from the perspective of the employing institution (Simpson, 1985).

Two criteria can be used to assess differences among the alternative equatings in the *score* metric. The first criterion is the root-mean-squared difference between a pair of equatings, with the difference at each score level weighted by the proportion of cases at that level on the circular-response answer sheet.²⁶ The second criterion is the proportion of cases (from the circular-response answer-sheet distribution) for which the two equatings differ by more than .5 standard score points (Department of Defense, 1988). The first criterion is an index of the algebraic difference between two sets of equated scores. The second criterion is an indicator of the practical impact of using one equating instead of the other.

Two criteria can be used to assess differences among alternative equatings in the *frequency* metric. The first criterion is the root mean squared difference between the cumulative distribution of equated scores (after linear interpolation at integer scores on the vertical-response answer sheet) and the cumulative distribution of scores on the vertical-response answer sheet, with the difference at each score level weighted by the proportion of cases at that level on the vertical-response answer sheet.²⁷ The second criterion is the proportion of cases (from the vertical-response answer-sheet distribution) for which the cumulative proportions differ by more than .01. The first criterion is an index of the algebraic difference between the equated-score and reference distributions. The second criterion is an indicator of the practical impact (on the score distribution) of using the equated circular-response answer sheet instead of the vertical-response answer sheet.

A procedure for choosing among alternative equatings is to use the two root-mean-squared-difference indices (in the score metric and in the frequency metric) to select the linear or smoothed-distribution equating with the best fit to the raw equipercentile equating. Then, the two indices of impact (in the score metric and in the frequency metric) can be used to assess whether an equating with fewer

²⁶ Only by applying these weights at these score levels do we obtain a measure that is based on the expected squared difference between equating functions (in the standard score metric).

²⁷ Only by applying these weights at these score levels do we obtain a measure that is based on the expected squared departure from the reference form distribution.

parameters could be employed without having a practical consequence for the equated scores or their cumulative distribution.

The following heuristics implement this procedure for selecting an equating for ASVAB tests. They specify cutting points on the indices employed to compare equatings. The cutting points have been chosen from a visual inspection of the results of applying them to the data from the OPCAL of ASVAB 15, 16 and 17. In choosing the points, an effort was made to provide some choice among alternative equatings where it seemed reasonable to have a choice, e.g., where two equatings with differing numbers of parameters provided visually similar equatings and visually similar equated-score distributions. An advantage of using cut points as specific as these is that the selection procedure can be replicated and evaluated. However, more research is required to assess the cross-validity of equatings selected by this method. Until such research provides further reassurances about these cutting points or provides more defensible alternatives, the last step, (5), in these heuristics provides a necessary confirmation that the selected equating is accurate at least for the test and sample in which the equating was developed.

The heuristics are:

1. Select the smooth equating that minimizes the root-mean-squared discrepancy in the score metric between the smooth equating (linear or smoothed-equipercntile) and the raw equipercntile equating;

then,

2. Compare the smooth equating from (1) with alternative smooth equatings that use fewer parameters; select the alternative equating with the fewest parameters if it has a root-mean-squared discrepancy in the frequency metric at least 10% less than the equating from (1) without having a root-mean-squared discrepancy in the score metric 10% higher than the equating from (1); if no such alternative smooth equating exists, use the selection from (1) as the best-fitting alternative;

then,

3. Compare the equating selected in (2) with other smooth equatings that use fewer parameters; find those equatings with fewer parameters that also differ from (2) by more than .5 standard score points for fewer than 10% of the cases;

then,

4. Select that equating from (3) that uses the fewest parameters and that results in fewer than 10% of the cases at scores where the equated cumulative distribution differs from the reference cumulative distribution by more than .01;

then,

5. Visually inspect the graphs of the differences among the selected equating, the raw equipercntile equating, the identity equating and the linear equating; also visually inspect the differences among the reference cumulative distribution (for the vertical-response answer sheet) and the distributions of equated scores based on the selected equating, the raw equipercntile equating, the identity equating and the linear equating.

Appendix E

Composite-Category by Answer-Sheet-Frequency Tables, after Answer-Sheet Score Conversion

**AFQT PERCENT COMPOSITE
TABLE OF CATQT BY FORMS**

CATQT Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
01-09	144 1.17 47.37 2.41	160 1.30 52.63 2.54	304 2.48
10-15	217 1.77 51.91 3.64	201 1.64 48.09 3.19	418 3.41
16-20	219 1.79 50.93 3.67	211 1.72 49.07 3.35	430 3.51
21-30	646 5.27 49.28 10.83	665 5.42 50.72 10.56	1311 10.69
31-49	1415 11.54 49.08 23.72	1468 11.97 50.92 23.32	2883 23.51
50-64	1219 9.94 46.81 20.43	1385 11.30 53.19 22.00	2604 21.24
65-92	1817 14.82 49.03 30.46	1889 15.41 50.97 30.01	3706 30.23
93-99	289 2.36 47.77 4.84	316 2.58 52.23 5.02	605 4.93
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATQT BY FORMS

Statistic	DF	Value	Prob
Chi-Square	7	7.216	0.407
Likelihood Ratio Chi-Square	7	7.218	0.407

**ARMY GT COMPOSITE
TABLE OF CATGT BY FORMS**

CATGT Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-109	3701	3926	7627
	30.19	32.02	62.21
	48.52	51.48	
	62.03	62.37	
110-160	2265	2369	4634
	18.47	19.32	37.79
	48.88	51.12	
	37.97	37.63	
Total	5966	6295	12261
	48.66	51.34	100.00

STATISTICS FOR TABLE OF CATGT BY FORMS

Statistic	DF	Value	Prob
Chi-Square	1	0.144	0.705
Likelihood Ratio Chi-Square	1	0.144	0.705

**ARMY GM COMPOSITE
TABLE OF CATGM BY FORMS**

CATGM Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-84	944 7.70 49.53 15.82	962 7.85 50.47 15.28	1906 15.55
85-89	480 3.91 50.53 8.05	470 3.83 49.47 7.47	950 7.75
90-94	577 4.71 47.92 9.67	627 5.11 52.08 9.96	1204 9.82
95-99	549 4.48 47.91 9.20	597 4.87 52.09 9.48	1146 9.35
100-104	710 5.79 50.25 11.90	703 5.73 49.75 11.17	1413 11.52
105-160	2706 22.07 47.96 45.36	2936 23.95 52.04 46.64	5642 46.02
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATGM BY FORMS

Statistic	DF	Value	Prob
Chi-Square	5	4.948	0.422
Likelihood Ratio Chi-Square	5	4.948	0.422

**ARMY EL COMPOSITE
TABLE OF CATEL BY FORMS**

CATEL Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-84	907 7.40 50.19 15.20	900 7.34 49.81 14.30	1807 14.74
85-89	507 4.14 48.52 8.50	538 4.39 51.48 8.55	1045 8.52
90-94	554 4.52 47.97 9.29	601 4.90 52.03 9.55	1155 9.42
95-99	587 4.79 50.39 9.84	578 4.71 49.61 9.18	1165 9.50
100-104	686 5.59 48.45 11.50	730 5.95 51.55 11.60	1416 11.55
105-109	592 4.83 45.29 9.92	715 5.83 54.71 11.36	1307 10.66
110-114	522 4.26 49.95 8.75	523 4.27 50.05 8.31	1045 8.52
115-119	533 4.35 49.31 8.93	548 4.47 50.69 8.71	1081 8.82
120-160	1078 8.79 48.13 18.07	1162 9.48 51.88 18.46	2240 18.27
Total	5966 48.66	6295 51.34	12261 100.00

**ARMY EL COMPOSITE
TABLE OF CATEL BY FORMS**
(Continued)

STATISTICS FOR TABLE OF CATEL BY FORMS

Statistic	DF	Value	Prob
Chi-Square	8	10.410	0.237
Likelihood Ratio Chi-Square	8	10.420	0.237

**ARMY CL COMPOSITE
TABLE OF CATCL BY FORMS**

CATCL Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-84	828 6.75 49.14 13.88	857 6.99 50.86 13.61	1685 13.74
85-89	429 3.50 50.29 7.19	424 3.46 49.71 6.74	853 6.96
90-94	481 3.92 50.16 8.06	478 3.90 49.84 7.59	959 7.82
95-99	674 5.50 49.67 11.30	683 5.57 50.33 10.85	1357 11.07
100-104	554 4.52 46.79 9.29	630 5.14 53.21 10.01	1184 9.66
105-109	664 5.42 46.37 11.13	768 6.26 53.63 12.20	1432 11.68
110-160	2336 19.05 48.76 39.16	2455 20.02 51.24 39.00	4791 39.08
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATCL BY FORMS

Statistic	DF	Value	Prob
Chi-Square	6	7.162	0.306
Likelihood Ratio Chi-Square	6	7.166	0.306

**ARMY MM COMPOSITE
TABLE OF CATMM BY FORMS**

CATMM Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-89	1229 10.02 48.69 20.60	1295 10.56 51.31 20.57	2524 20.59
90-94	583 4.75 51.46 9.77	550 4.49 48.54 8.74	1133 9.24
95-99	639 5.21 46.47 10.71	736 6.00 53.53 11.69	1375 11.21
100-104	625 5.10 47.86 10.48	681 5.55 52.14 10.82	1306 10.65
105-160	2890 23.57 48.79 48.44	3033 24.74 51.21 48.18	5923 48.31
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATMM BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	6.560	0.161
Likelihood Ratio Chi-Square	4	6.562	0.161

**ARMY SC COMPOSITE
TABLE OF CATSC BY FORMS**

CATSC Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-89	1344 10.96 49.47 22.53	1373 11.20 50.53 21.81	2717 22.16
90-94	581 4.74 48.70 9.74	612 4.99 51.30 9.72	1193 9.73
95-94	596 4.86 48.30 9.99	638 5.20 51.70 10.14	1234 10.06
100-104	606 4.94 49.43 10.16	620 5.06 50.57 9.85	1226 10.00
105-160	2839 23.15 48.19 47.59	3052 24.89 51.81 48.48	5891 48.05
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATSC BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	1.579	0.813
Likelihood Ratio Chi-Square	4	1.579	0.813

**ARMY CO COMPOSITE
TABLE OF CATCO BY FORMS**

CATCO Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-84	786 6.41 49.56 13.17	800 6.52 50.44 12.71	1586 12.94
85-89	468 3.82 47.56 7.84	516 4.21 52.44 8.20	984 8.03
90-94	586 4.78 51.05 9.82	562 4.58 48.95 8.93	1148 9.36
95-99	570 4.65 46.45 9.55	657 5.36 53.55 10.44	1227 10.01
100-160	3556 29.00 48.61 59.60	3760 30.67 51.39 59.73	7316 59.67
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATCO BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	6.000	0.199
Likelihood Ratio Chi-Square	4	6.002	0.199

**ARMY FA COMPOSITE
TABLE OF CATFA BY FORMS**

CATFA Frequency Percent Row Pct Col Pct	FORMS		
	15C	15H	Total
	-----+-----+-----+		
	-----+-----+-----+		
40-84	694 5.66 50.47 11.63	681 5.55 49.53 10.82	1375 11.21
85-89	42 3.48 50.00 7.16	427 3.48 50.00 6.78	854 6.97
90-94	523 4.27 47.85 8.77	570 4.65 52.15 9.05	1093 8.91
95-99	658 5.37 47.75 11.03	720 5.87 52.25 11.44	1378 11.24
100-160	3664 29.88 48.46 61.41	3897 31.78 51.54 61.91	7561 61.67
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATFA BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	3.288	0.511
Likelihood Ratio Chi-Square	4	3.287	0.511

**ARMY OF COMPOSITE
TABLE OF CATOF BY FORMS**

CATOF Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-89	1029 8.39 49.69 17.25	1042 8.50 50.31 16.55	2071 16.89
90-94	571 4.66 48.68 9.57	602 4.91 51.32 9.56	1173 9.57
95-94	620 5.06 48.59 10.39	656 5.35 51.41 10.42	1276 10.41
100-104	667 5.44 48.69 11.18	703 5.73 51.31 11.17	1370 11.17
105-160	3079 25.11 48.33 51.61	3292 26.85 51.67 52.30	6371 51.96
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATOF BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	1.156	0.885
Likelihood Ratio Chi-Square	4	1.156	0.885

**ARMY ST COMPOSITE
TABLE OF CATST BY FORMS**

CATST Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-84	789 6.44 50.45 13.22	775 6.32 49.55 12.31	1564 12.76
85-89	419 3.42 46.20 7.02	488 3.98 53.80 7.75	907 7.40
90-94	562 4.58 49.78 9.42	567 4.62 50.22 9.01	1129 9.21
95-99	664 5.42 51.12 11.13	635 5.18 48.88 10.09	1299 10.59
100-104	573 4.67 46.81 9.60	651 5.31 53.19 10.34	1224 9.98
105-109	711 5.80 49.41 11.92	728 5.94 50.59 11.56	1439 11.74
110-114	634 5.17 46.72 10.63	723 5.90 53.28 11.49	1357 11.07
115-160	1614 13.16 48.29 27.05	1728 14.09 51.71 27.45	3342 27.26
Total	5966 48.66	6295 51.34	12261 100.00

**ARMY ST COMPOSITE
TABLE OF CATST BY FORMS**
(Continued)

STATISTICS FOR TABLE OF CATST BY FORMS

Statistic	DF	Value	Prob
Chi-Square	7	12.122	0.097
Likelihood Ratio Chi-Square	7	12.126	0.097

**NAVY BC COMPOSITE
TABLE OF CATBC BY FORMS**

CATBC Frequency Percent Row Pct Col Pct	FORMS		
	15C	15H	Total
60-146	1688 13.77 50.25 28.29	1671 13.63 49.75 26.54	3359 27.40
147-152	637 5.20 47.57 10.68	702 5.73 52.43 11.15	1339 10.92
153-240	3641 29.70 48.14 61.03	3922 31.99 51.86 62.30	7563 61.68
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATBC BY FORMS

Statistic	DF	Value	Prob
Chi-Square	2	4.857	0.088
Likelihood Ratio Chi-Square	2	4.856	0.088

**NAVY EL COMPOSITE
TABLE OF CATEL BY FORMS**

CATEL Frequency Percent Row Pct Col Pct	FORMS		
	15C	15H	Total
80-189	1903 15.52 49.03 31.90	1978 16.13 50.97 31.42	3881 31.65
190-199	739 6.03 50.83 12.39	715 5.83 49.17 11.36	1454 11.86
200-203	312 2.54 50.73 5.23	303 2.47 49.27 4.81	615 5.02
204-217	954 7.78 45.67 15.99	1135 9.26 54.33 18.03	2089 17.04
218-320	2058 16.78 48.74 34.50	2164 17.65 51.26 34.38	4222 34.43
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATEL BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	11.501	0.021
Likelihood Ratio Chi-Square	4	11.512	0.021

**NAVY E COMPOSITE
TABLE OF CATE BY FORMS**

CATE Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
80-195	2274 18.55 49.30 38.12	2339 19.08 50.70 37.16	4613 37.62
196-199	294 2.40 49.75 4.93	297 2.42 50.25 4.72	591 4.82
200-203	268 2.19 48.82 4.49	281 2.29 51.18 4.46	549 4.48
204-209	398 3.25 47.38 6.67	442 3.60 52.62 7.02	840 6.85
210-213	265 2.16 47.15 4.44	297 2.42 52.85 4.72	562 4.58
214-320	2467 20.12 48.32 41.35	2639 21.52 51.68 41.92	5106 41.64
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATE BY FORMS

Statistic	DF	Value	Prob
Chi-Square	5	2.333	0.801
Likelihood Ratio Chi-Square	5	2.334	0.801

**NAVY CL COMPOSITE
TABLE OF CATCL BY FORMS**

CATCL Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
60-159	2950 24.06 49.07 49.45	3062 24.97 50.93 48.64	6012 49.03
160-240	3016 24.60 48.26 50.55	3233 26.37 51.74 51.36	6249 50.97
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATCL BY FORMS

Statistic	DF	Value	Prob
Chi-Square	1	0.794	0.373
Likelihood Ratio Chi-Square	1	0.794	0.373

NAVY GT COMPOSITE TABLE OF CATGT BY FORMS

CATGT Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-88	1036 8.45 49.15 17.37	1072 8.74 50.85 17.03	2108 17.19
89-95	782 6.38 50.65 13.11	762 6.21 49.35 12.10	1544 12.59
96-96	146 1.19 49.83 2.45	147 1.20 50.17 2.34	293 2.39
97-102	813 6.63 47.74 13.63	890 7.26 52.26 14.14	1703 13.89
103-107	750 6.12 45.98 12.57	881 7.19 54.02 14.00	1631 13.30
108-112	770 6.28 49.11 12.91	798 6.51 50.89 12.68	1568 12.79
113-114	288 2.35 50.79 4.83	279 2.28 49.21 4.43	567 4.62
115-160	1381 11.26 48.51 23.15	1466 11.96 51.49 23.29	2847 23.22
Total	5966 48.66	6295 51.34	12261 100.00

**NAVY GT COMPOSITE
TABLE OF CATGT BY FORMS**
(Continued)

STATISTICS FOR TABLE OF CATGT BY FORMS

Statistic	DF	Value	Prob
Chi-Square	7	9.240	0.236
Likelihood Ratio Chi-Square	7	9.245	0.236

**NAVY ME COMPOSITE
TABLE OF CATME BY FORMS**

CATME Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
60-149	2549 20.79 49.31 42.73	2620 21.37 50.69 41.62	5169 42.16
150-157	770 6.28 48.28 12.91	825 6.73 51.72 13.11	1595 13.01
158-166	815 6.65 48.43 13.66	868 7.08 51.57 13.79	1683 13.73
167-240	1832 14.94 48.03 30.71	1982 16.17 51.97 31.49	3814 31.11
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATME BY FORMS

Statistic	DF	Value	Prob
Chi-Square	3	1.613	0.656
Likelihood Ratio Chi-Square	3	1.613	0.656

**NAVY EG COMPOSITE
TABLE OF CATEG BY FORMS**

CATEG	FORMS		
Frequency			
Percent			
Row Pct			
Col Pct	15C	15H	Total
40-95	1904	1947	3851
	15.53	15.88	31.41
	49.44	50.56	
	31.91	30.93	
96-160	4062	4348	8410
	33.13	35.46	68.59
	48.30	51.70	
	68.09	69.07	
Total	5966	6295	12261
	48.66	51.34	100.00

STATISTICS FOR TABLE OF CATEG BY FORMS

Statistic	DF	Value	Prob
Chi-Square	1	1.379	0.240
Likelihood Ratio Chi-Square	1	1.379	0.240

**NAVY CT COMPOSITE
TABLE OF CATCT BY FORMS**

CATCT	FORMS		
	Frequency		
	Percent		
	Row Pct		
Col Pct	15C	15H	Total
80-201	2102	2153	4255
	17.14	17.56	34.70
	49.40	50.60	
	35.23	34.20	
202-320	3864	4142	8006
	31.51	33.78	65.30
	48.26	51.74	
	64.77	65.80	
Total	5966	6295	12261
	48.66	51.34	100.00

STATISTICS FOR TABLE OF CATCT BY FORMS

Statistic	DF	Value	Prob
Chi-Square	1	1.438	0.231
Likelihood Ratio Chi-Square	1	1.437	0.231

**NAVY HM COMPOSITE
TABLE OF CATHM BY FORMS**

CATHM	FORMS		
Frequency			
Percent			
Row Pct			
Col Pct	15C	15H	Total
60-148	2261 18.44 49.93 37.90	2267 18.49 50.07 36.01	4528 36.93
149-164	1681 13.71 47.93 28.18	1826 14.89 52.07 29.01	3507 28.60
165-240	2024 16.51 47.89 33.93	2202 17.96 52.11 34.98	4226 34.47
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATHM BY FORMS

Statistic	DF	Value	Prob
Chi-Square	2	4.676	0.097
Likelihood Ratio Chi-Square	2	4.675	0.097

**NAVY ST COMPOSITE
TABLE OF CATST BY FORMS**

CATST Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
60-146	87 0.71 48.33 1.46	93 0.76 51.67 1.48	180 1.47
147-240	5879 47.95 48.66 98.54	6202 50.58 51.34 98.52	12081 98.53
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATST BY FORMS

Statistic	DF	Value	Prob
Chi-Square	1	0.008	0.930
Likelihood Ratio Chi-Square	1	0.008	0.930

**NAVY MR COMPOSITE
TABLE OF CATMR BY FORMS**

CATMR Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
60-129	1046	1105	2151
	8.53	9.01	17.54
	48.63	51.37	
	17.53	17.55	
130-157	2319	2417	4736
	18.91	19.71	38.63
	48.97	51.03	
	38.87	38.40	
158-163	478	543	1021
	3.90	4.43	8.33
	46.82	53.18	
	8.01	8.63	
164-240	2123	2230	4353
	17.32	18.19	35.50
	48.77	51.23	
	35.58	35.42	
Total	5966	6295	12261
	48.66	51.34	100.00

STATISTICS FOR TABLE OF CATMR BY FORMS

Statistic	DF	Value	Prob
Chi-Square	3	1.587	0.662
Likelihood Ratio Chi-Square	3	1.589	0.662

AIR FORCE M COMPOSITE TABLE OF CATM BY FORMS

CATM Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
01-43	2352 19.18 49.21 39.42	2428 19.80 50.79 38.57	4780 38.99
44-44	31 0.25 48.44 0.52	33 0.27 51.56 0.52	64 0.52
45-50	402 3.28 48.38 6.74	429 3.50 51.62 6.81	831 6.78
51-56	354 2.89 49.30 5.93	364 2.97 50.70 5.78	718 5.86
57-60	314 2.56 47.87 5.26	342 2.79 52.13 5.43	656 5.35
61-88	1962 16.00 48.92 32.89	2049 16.71 51.08 32.55	4011 32.71
89-99	551 4.49 45.88 9.24	650 5.30 54.12 10.33	1201 9.80
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATM BY FORMS

Statistic	DF	Value	Prob
Chi-Square	6	4.706	0.582
Likelihood Ratio Chi-Square	6	4.711	0.581

AIR FORCE A COMPOSITE TABLE OF CATA BY FORMS

CATA Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
01-26	719 5.86 49.11 12.05	745 6.08 50.89 11.83	1464 11.94
27-31	311 2.54 52.01 5.21	287 2.34 47.99 4.56	598 4.88
32-39	489 3.99 48.32 8.20	523 4.27 51.68 8.31	1012 8.25
40-44	315 2.57 49.37 5.28	323 2.63 50.63 5.13	638 5.20
45-50	454 3.70 47.24 7.61	507 4.14 52.76 8.05	961 7.84
51-60	800 6.52 49.26 13.41	824 6.72 50.74 13.09	1624 13.25
61-66	405 3.30 46.55 6.79	465 3.79 53.45 7.39	870 7.10
67-99	2473 20.17 48.55 41.45	2621 21.38 51.45 41.64	5094 41.55
Total	5966 48.66	6295 51.34	12261 100.00

**AIR FORCE A COMPOSITE
TABLE OF CATA BY FORMS**
(Continued)

STATISTICS FOR TABLE OF CATA BY FORMS

Statistic	DF	Value	Prob
Chi-Square	7	5.559	0.592
Likelihood Ratio Chi-Square	7	5.560	0.592

AIR FORCE G COMPOSITE TABLE OF CATG BY FORMS

CATG	FORMS		Total
	Frequency Percent Row Pct Col Pct		
	15C	15H	
01-29	1142 9.31 49.83 19.14	1150 9.38 50.17 18.27	2292 18.69
30-34	421 3.43 49.24 7.06	434 3.54 50.76 6.89	855 6.97
35-38	255 2.08 50.50 4.27	250 2.04 49.50 3.97	505 4.12
39-41	283 2.31 49.74 4.74	286 2.33 50.26 4.54	569 4.64
42-42	124 1.01 50.20 2.08	123 1.00 49.80 1.95	247 2.01
43-47	274 2.23 47.57 4.59	302 2.46 52.43 4.80	576 4.70
48-49	142 1.16 47.02 2.38	160 1.30 52.98 2.54	302 2.46
50-52	299 2.44 47.46 5.01	331 2.70 52.54 5.26	630 5.14
53-55	308 2.51 46.53 5.16	354 2.89 53.47 5.62	662 5.40
56-57	125 1.02 42.09 2.10	172 1.40 57.91 2.73	297 2.42

**AIR FORCE G COMPOSITE
TABLE OF CATG BY FORMS**
(Continued)

58-63	328 2.68 47.40 5.50	364 2.97 52.60 5.78	692 5.64
64-68	444 3.62 48.79 7.44	466 3.80 51.21 7.40	910 7.42
70-99	1821 14.85 48.90 30.52	1903 15.52 51.10 30.23	3724 30.37
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATG BY FORMS

Statistic	DF	Value	Prob
Chi-Square	12	10.378	0.583
Likelihood Ratio Chi-Square	12	10.406	0.580

AIR FORCE E COMPOSITE TABLE OF CATE BY FORMS

CATE Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
01-32	1292 10.54 49.35 21.66	1326 10.81 50.65 21.06	2618 21.35
33-38	431 3.52 49.48 7.22	440 3.59 50.52 6.99	871 7.10
39-42	245 2.00 47.30 4.11	273 2.23 52.70 4.34	518 4.22
43-44	224 1.83 48.80 3.75	235 1.92 51.20 3.73	459 3.74
45-45	62 0.51 46.62 1.04	71 0.58 53.38 1.13	133 1.08
46-49	301 2.45 52.53 5.05	272 2.22 47.47 4.32	573 4.67
50-57	686 5.59 48.45 11.50	730 5.95 51.55 11.60	1416 11.55
58-66	667 5.44 45.97 11.18	784 6.39 54.03 12.45	1451 11.83
67-71	382 3.12 49.04 6.40	397 3.24 50.96 6.31	779 6.35
72-76	358 2.92 49.18 6.00	370 3.02 50.82 5.88	728 5.94

**AIR FORCE E COMPOSITE
TABLE OF CATE BY FORMS**
(Continued)

77-80	287 2.34 49.14 4.81	297 2.42 50.86 4.72	584 4.76
81-99	1031 8.41 48.38 17.28	1100 8.97 51.62 17.47	2131 17.38
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATE BY FORMS

Statistic	DF	Value	Prob
Chi-Square	11	9.260	0.598
Likelihood Ratio Chi-Square	11	9.265	0.597

**MARINE CORPS MM COMPOSITE
TABLE OF CATMM BY FORMS**

CATMM Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-84	1024 8.35 48.35 17.16	1094 8.92 51.65 17.38	2118 17.27
85-94	1114 9.09 49.96 18.67	1116 9.10 50.04 17.73	2230 18.19
95-104	1102 8.99 47.95 18.47	1196 9.75 52.05 19.00	2298 18.74
105-114	1169 9.53 48.81 19.59	1226 10.00 51.19 19.48	2395 19.53
115-160	1557 12.70 48.35 26.10	1663 13.56 51.65 26.42	3220 26.26
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATMM BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	2.180	0.703
Likelihood Ratio Chi-Square	4	2.180	0.703

**MARINE CORPS CL COMPOSITE
TABLE OF CATCL BY FORMS**

CATCL Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-79	279 2.28 49.73 4.68	282 2.30 50.27 4.48	561 4.58
80-89	589 4.80 50.56 9.87	576 4.70 49.44 9.15	1165 9.50
90-99	1139 9.29 49.76 19.09	1150 9.38 50.24 18.27	2289 18.67
101-109	1426 11.63 46.89 23.90	1615 13.17 53.11 25.66	3041 24.80
110-119	1458 11.89 48.36 24.44	1557 12.70 51.64 24.73	3015 24.59
120-160	1075 8.77 49.09 18.02	1115 9.09 50.91 17.71	2190 17.86
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLES OF CATCL BY FORMS

Statistic	DF	Value	Prob
Chi-Square	5	7.119	0.212
Likelihood Ratio Chi-Square	5	7.121	0.212

**MARINE CORPS GT COMPOSITE
TABLE OF CATGT BY FORMS**

CATGT Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-79	532 4.34 51.80 8.92	495 4.04 48.20 7.86	1027 8.38
80-89	791 6.45 47.79 13.26	864 7.05 52.21 13.73	1655 13.50
90-99	1128 9.20 48.56 18.91	1195 9.75 51.44 18.98	2323 18.95
100-109	1243 10.14 48.44 20.83	1323 10.79 51.56 21.02	2566 20.93
110-160	2272 18.53 48.44 38.08	2418 19.72 51.56 38.41	4690 38.25
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATGT BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	4.700	0.320
Likelihood Ratio Chi-Square	4	4.698	0.320

**MARINE CORPS EL COMPOSITE
TABLE OF CATEL BY FORMS**

CATEL Frequency Percent Row Pct Col Pct	FORMS		Total
	15C	15H	
40-89	1414 11.53 49.58 23.70	1438 11.73 50.42 22.84	2852 23.26
90-99	1141 9.31 49.18 19.13	1179 9.62 50.82 18.73	2320 18.92
100-109	1278 10.42 46.93 21.42	1445 11.79 53.07 22.95	2723 22.21
110-114	582 4.75 49.70 9.76	589 4.80 50.30 9.36	1171 9.55
115-160	1551 12.65 48.54 26.00	1644 13.41 51.46 26.12	3195 26.06
Total	5966 48.66	6295 51.34	12261 100.00

STATISTICS FOR TABLE OF CATEL BY FORMS

Statistic	DF	Value	Prob
Chi-Square	4	4.991	0.288
Likelihood Ratio Chi-Square	4	4.993	0.288

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ASVAB OMR IOT&E SUPPLEMENT

Tables 1-46 and Figures 1-10

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TABLE OF TABLES

Table 1	ASVAB Tests, Numbers of Items, Time Limits, and Normative Means and Standard Deviations	S-1
Table 2	Sample Size, by Stage of Data Editing	S-2
Table 3	Sample Size, by Test Form and Type of Answer Sheet	S-3
Table 4	Tests of Independence of Test Form and Type of Answer Sheet from Gender, Education, and Ethnicity	S-4
Table 5	Sample Size, by Gender, Ethnicity, Education, and Type of Answer Sheet	S-5
Table 6	Sample Size, by Test Form and Education	S-6
Table 7	Speed Test Means, Standard Deviations and Answer-Sheet Effect Size Estimates, by ASVAB Form	S-7
Table 8	Chi-Square Tests of Answer-Sheet Effects for Power Tests	S-8
Table 9	Power Test Means, Standard Deviations and Answer-Sheet Effect Size Estimates, by ASVAB Form	S-9
Table 10	Chi-Square Tests of ASVAB Form Effects for NO and CS Tests, by Type of Answer Sheet	S-11
Table 11	ASVAB Form Effect Size Estimates for NO and CS Tests, by Type of Answer Sheet	S-12
Table 12	Indices for Selecting Equating Functions, for NO and CS	S-13
Table 13	Statistics and Number of Terms in Polynomial Log-Linear Smoothing of Distributions Used for Equating, for NO and CS	S-14
Table 14	Statistics for NO and CS Distributions after Calibration of Circular-Response Answer Sheet, by ASVAB Form	S-15
Table 15	NO and CS Means, Standard Deviations and Answer-Sheet Effect Size Estimates after Calibration, by ASVAB Form	S-16
Table 16	Distribution Frequencies, Number-Right Equivalents, and Unrounded Standard Score Equivalents of NO Number-Right on Circular-Response Answer Sheet	S-17

Table 17	Distribution Frequencies, Number-Right Equivalents, and Unrounded Standard Score Equivalents of CS Number-Right on Circular-Response Answer Sheet.....	S-19
Table 18	ASVAB Forms 8f/8g/9f/9g/10f/10g/13h/14f/14g/14h/15h/18h Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-21
Table 19	Correspondence of ASVAB Test Booklets with Form Designations under Vertical-Response and Circular-Response Answer Sheets.....	S-23
Table 20	Order of Linking ASVAB Form Equatings and Circular-Response Answer-Sheet Equatings.....	S-24
Table 21	Means, Standard Deviations and Linear Equatings for NO and CS from IOT&E's of ASVAB 11/12/13 and ASVAB 15/16/17.....	S-25
Table 22	Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for NO on ASVAB 11/12/13 and ASVAB 15/16/17	S-26
Table 23	Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for NO on ASVAB 18/19 and ASVAB 20/21/22.....	S-28
Table 24	Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for CS on ASVAB 11/12/13 and ASVAB 15/16/17.....	S-30
Table 25	Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for CS on ASVAB 18/19 and ASVAB 20/21/22.....	S-32
Table 26	ASVAB Forms 11f/11g/12g/13f/13g Conversion of Raw Test Scores to 1980 Standard Score Equivalents	S-34
Table 27	ASVAB Form 12f Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-36
Table 28	ASVAB Form 15f Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-38
Table 29	ASVAB Form 15g Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-40
Table 30	ASVAB Form 16f Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-42
Table 31	ASVAB Form 16g Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-44

Table 32	ASVAB Form 17f Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-46
Table 33	ASVAB Form 17g Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-48
Table 34	ASVAB Form 18f Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-50
Table 35	ASVAB Form 18g Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-52
Table 36	ASVAB Form 19f Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-54
Table 37	ASVAB Form 19g Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-56
Table 38	ASVAB Form 20a Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-58
Table 39	ASVAB Form 20b Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-60
Table 40	ASVAB Form 21a Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-62
Table 41	ASVAB Form 21b Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-64
Table 42	ASVAB Form 22a Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-66
Table 43	ASVAB Form 22b Conversion of Raw Test Scores to 1980 Standard Score Equivalents.....	S-68
Table 44	ASVAB Test Score Composites	S-70
Table 45	Composite Cutting Scores Used to Classify Subjects.....	S-71
Table 46	Answer-Sheet by Composite Category Chi-Squares for ASVAB Reference Form (15c).....	S-72

TABLE OF FIGURES

Figure 1	Vertical-Response Answer Sheet for Enlistment ASVAB	S-73
Figure 2	Circular-Response Answer Sheet for Enlistment ASVAB.....	S-77
Figure 3	Answer Sheet Usage, By Total Number Tested at Test Site	S-81
Figure 4	Unsmoothed and Quartic and Polynomial Log-Linear Smoothed Distributions for NO on Vertical- and Circular-Response Answer Sheets.....	S-82
Figure 5	Unsmoothed and Quartic and Polynomial Log-Linear Smoothed Distributions for CS on Vertical- and Circular-Response Answer Sheets	S-83
Figure 6	Standard Score Contrast of Alternative Equatings with Linear Identity Equating, and Contrasts of Equated-Score Distributions with Vertical-Response Answer Sheet Distribution, for NO	S-84
Figure 7	Standard Score Contrast of Alternative Equatings with Linear Identity Equating, and Contrasts of Equated-Score Distributions with Vertical-Response Answer Sheet Distribution, for CS	S-85
Figure 8	Standard Score Contrast of Selected Equatings with Linear Identity Equating, with and without Use of Pooled Distributions.....	S-86
Figure 9	Answer-sheet Effect Size before and after Answer-Sheet Calibration, by ASVAB Form and Test.....	S-87
Figure 10	Standard Score Contrast of Equated Scores with Linear Identity Equating: Results of Three Answer-Sheet Studies	S-88

ASVAB OMR IOT&E SUPPLEMENT TABLES 1-46

Table 1**ASVAB Tests, Numbers of Items, Time Limits
and Normative Means and Standard Deviations***

<u>Tests</u> <u>(In order of administration)</u>	<u>Items</u>	<u>Time:</u> <u>Minutes</u>	<u>Mean</u>	<u>S.D.</u>
General Science (GS)	25	11	15.950	5.010
Arithmetic Reasoning (AR)	30	36	18.009	7.373
Word Knowledge (WK)	35	11	26.270	7.710
Paragraph Comprehension (PC)	15	13	11.011	3.355
Numerical Operations (NO)	50	3	37.236	10.800
Coding Speed (CS)	84	7	47.606	16.763
Auto and Shop Information (AS)	25	11	14.317	5.550
Math Knowledge (MK)	25	24	13.578	6.393
Mechanical Comprehension (MC)	25	19	14.165	5.349
Electronics Information (EI)	20	9	11.569	4.236
Verbal Composite Score (VE) (treated as a test)**	50	-	37.281	10.595

*Means and standard deviations are from an administration of the reference form to a sample of the 18-to-23-year-old American youth population (Department of Defense, 1982).

**The Verbal composite is a combination of the Word Knowledge and Paragraph Comprehension raw scores (VE = WK + PC).

Table 2
Sample Size, by Stage of Data Editing

<u>Category of Edit</u>	<u>Number Edited</u>	<u>Percent Edited</u>	<u>Subjects Remaining</u>	<u>Cumulative Percent Remaining</u>
(All subjects)	---	---	117,379	100.0%
Overseas testing	156	0.1%	117,223	99.9%
Retesters	19,292	16.5%	97,931	83.4%
Testing sessions*	8931	9.1%	89,000	75.8%
Vertical-response answer sheets only	(3097)	(3.2%)		
Circular-response answer sheets only	(4549)	(4.6%)		
Mixture of answer sheets	(1285)	(1.3%)		
Testing locations**	10,830	12.2%	78,170	66.6%

*Data were removed if they came from sessions in which the number tested with the vertical-response answer sheet differed by more than 7 from the number tested with the circular-response answer sheet.

**Data were removed if they came from testing locations which used the vertical-response answer sheets for less than 10% or more than 90% of the subjects during the course of the data collection.

Table 3**Sample Size, by Test Form and Type of Answer Sheet**

<u>Test Form</u>	Type of Answer Sheet	
	<u>Vertical-Response</u>	<u>Circular-Response</u>
15c/h	5966 (48.7%)	6295 (51.3%)
15a/f	5716 (48.8%)	5999 (51.2%)
15b/g	5769 (49.7%)	5850 (50.3%)
16a/f	5777 (50.1%)	5752 (49.9%)
16b/g	5525 (49.3%)	5681 (50.7%)
17a/f	5366 (50.6%)	5241 (49.4%)
17b/g	4633 (50.2%)	4600 (49.8%)
Total	38752	39418

Table 4

Tests of Independence of Test Form and Type of Answer Sheet
from Gender, Education, and Ethnicity

<u>Effect</u>	<u>Degrees of Freedom</u>	<u>Chi-Square</u>
Gender x Answer Sheet	1	2.671
Gender x Test Form	6	2.330
Gender x Combination of Answer Sheet and Test Form	6	6.262
Education* x Answer Sheet	2	2.839
Education x Test Form	12	31.709**
Education x Combination of Answer Sheet and Test Form	12	18.580
Ethnicity*** x Answer Sheet	1	1.327
Ethnicity x Test Form	6	5.735
Ethnicity x Combination of Answer Sheet and Test Form	6	5.993

*The categories of education were High-School Diploma, Post-Secondary Education, and Other.

** $P < .01$ All other chi-square values non-significant at $\alpha = .05$.

***Categories of ethnicity were Caucasian and Other.

Table 5**Sample Size, by Gender, Education, Ethnicity, and Type of Answer Sheet**

	Type of Answer Sheet	
	<u>Vertical-Response</u>	<u>Circular-Response</u>
Gender		
Male	30861 (79.6%)	31205 (79.2%)
Female	7891 (20.4%)	8213 (20.8%)
Education		
No High School Diploma	16350 (42.2%)	16465 (41.8%)
High School Diploma	21006 (54.2%)	21460 (54.4%)
Post-Secondary	1396 (3.6%)	1493 (3.8%)
Ethnicity		
Caucasian	28756 (74.2%)	29392 (74.6%)
Other	9996 (25.8%)	10026 (25.4%)
Total	38752	39418

Table 6
Sample Size, by Test Form and Education

Test Form	Education		
	No High School <u>Diploma</u>	High School <u>Diploma</u>	Post- <u>Secondary</u>
15c/h	5105 (41.6%)	6723 (54.8%)	433 (3.5%)
15a/f	4860 (41.5%)	6462 (55.2%)	393 (3.4%)*
15b/g	4855 (41.8%)	6335 (54.5%)	429 (3.7%)
16a/f	4697 (40.7%)*	6371 (55.3%)	461 (4.0%)*
16b/g	4750 (42.4%)	6028 (53.8%)	428 (3.8%)
17a/f	4624 (43.6%)*	5585 (52.7%)*	398 (3.8%)
17b/g	3924 (42.5%)	4962 (53.7%)	347 (3.8%)
Total	32815	42466	2889

*Cells contributed more than $\chi^2/d.f.$ to the total χ^2 .

Table 7

**Speed Test Means, Standard Deviations and Answer-Sheet Effect Size Estimates,
by ASVAB Form**

Test	Vertical-Response Answer Sheet			Circular-Response Answer Sheet		Effect Size*
	ASVAB Form	Mean	Standard Deviation	Mean	Standard Deviation	
NO						
	15c	40.848	8.283	37.529	8.679	0.307
	15a	39.624	8.832	36.607	8.866	0.279
	15b	40.562	8.532	37.057	8.595	0.325
	16a	41.787	7.876	38.211	8.507	0.331
	16b	40.717	8.385	37.206	8.523	0.325
	17a	41.089	8.200	37.872	8.526	0.298
	17b	40.738	8.489	37.453	8.589	0.304
CS						
	15c	52.446	12.866	51.390	12.681	0.063
	15a	52.659	12.916	51.756	12.630	0.054
	15b	53.118	13.153	51.634	12.740	0.089
	16a	52.636	12.871	50.832	12.438	0.108
	16b	53.104	12.629	51.367	12.132	0.104
	17a	53.659	12.527	52.210	12.263	0.086
	17b	53.073	12.967	51.428	12.401	0.098

*Mean number-right on vertical-response answer sheet minus mean number-right on circular-response answer sheet, divided by standard deviation in reference population (see Table 1).

Table 8
Chi-Square Tests of Answer-Sheet Effects
for Power Tests

<u>Test</u>	<u>d.f.</u>	<u>Chi-Square*</u>	<u>Probability</u>
GS	47	54.639	.207
AR	49	68.212	.036
AS	55	65.430	.159
MK	57	75.124	.054
MC	58	71.449	.110
EI	54	54.270	.464
VE**	65	84.421	.053

*All chi-squares non-significant at $\alpha = .05/7 = .00714$.

**VE is sum of WK and PC scores, with the latter scores not being used alone in operational composites. For completeness of reporting here, the chi-squares for WK and PC were 72.164 (d.f. = 56, $p = .072$) and 42.696 (d.f. = 43, $p = .484$), respectively.

Table 9

**Power Test Means, Standard Deviations and Answer-Sheet Effect Size Estimates,
by ASVAB form**

Test	Vertical-Response Answer Sheet			Circular-Response Answer Sheet		
	ASVAB Form	Mean	Standard Deviation	Mean	Standard Deviation	Effect Size
GS	15c	16.254	4.356	16.445	4.316	-0.038
	15a	16.568	4.531	16.770	4.492	-0.040
	15b	16.737	4.448	16.812	4.476	-0.015
	16a	16.874	4.599	17.049	4.603	-0.035
	16b	17.045	4.583	17.019	4.602	0.005
	17a	16.606	4.476	16.646	4.424	-0.008
	17b	16.671	4.417	16.589	4.449	0.016
AR	15c	18.907	6.326	18.941	6.326	-0.005
	15a	19.099	6.237	19.357	6.194	-0.035
	15b	19.394	6.264	19.308	6.263	0.012
	16a	19.522	5.910	19.618	5.828	-0.013
	16b	19.449	6.324	19.309	6.361	0.019
	17a	19.506	6.423	19.557	6.513	-0.007
	17b	19.366	6.395	19.207	6.214	0.022
WK	15c	27.262	5.512	27.455	5.454	-0.025
	15a	26.800	6.298	27.100	6.146	-0.039
	15b	27.043	5.742	27.164	5.768	-0.016
	16a	27.355	5.716	27.524	5.653	-0.022
	16b	27.585	5.527	27.514	5.473	0.009
	17a	27.842	5.897	27.909	5.937	-0.009
	17b	27.489	5.864	27.551	5.690	-0.008
PC	15c	11.445	2.659	11.515	2.624	-0.021
	15a	12.316	2.556	12.414	2.476	-0.029
	15b	12.298	2.568	12.300	2.557	-0.000
	16a	12.368	2.671	12.363	2.711	0.001
	16b	12.142	2.582	12.119	2.572	0.007
	17a	12.331	2.567	12.374	2.528	-0.013
	17b	12.145	2.452	12.164	2.408	-0.006
AS	15c	14.559	4.982	14.639	5.028	-0.014
	15a	14.442	5.157	14.427	5.105	0.003
	15b	14.297	5.138	14.315	5.092	-0.003
	16a	13.797	6.020	14.084	5.995	-0.052
	16b	13.799	5.916	13.905	6.001	-0.019
	17a	14.954	5.359	14.851	5.377	0.019
	17b	14.618	5.422	14.679	5.399	-0.011

(continued)

Table 9
(continued)

**Power Test Means, Standard Deviations and Answer-Sheet Effect Size Estimates,
by ASVAB Form**

Test	Vertical-Response Answer Sheet			Circular-Response Answer Sheet		
	ASVAB Form	Mean	Standard Deviation	Mean	Standard Deviation	Effect Size
MK	15c	15.128	5.584	15.182	5.541	-0.008
	15a	15.481	5.518	15.756	5.442	-0.043
	15b	15.618	5.459	15.491	5.389	0.020
	16a	15.437	5.588	15.554	5.659	-0.018
	16b	15.566	5.658	15.410	5.616	0.024
	17a	15.557	5.311	15.612	5.303	-0.009
	17b	15.495	5.447	15.329	5.327	0.026
MC	15c	14.984	5.016	15.048	5.017	-0.012
	15a	15.809	4.791	15.934	4.725	-0.023
	15b	15.696	4.746	15.751	4.680	-0.010
	16a	16.114	4.660	16.237	4.605	-0.023
	16b	16.167	4.597	16.195	4.629	-0.005
	17a	16.013	4.445	16.028	4.418	-0.003
	17b	16.135	4.370	16.045	4.374	0.017
EI	15c	11.649	3.663	11.664	3.672	-0.003
	15a	11.647	3.596	11.709	3.628	-0.015
	15b	11.713	3.633	11.717	3.606	-0.001
	16a	12.069	3.845	12.233	3.818	-0.039
	16b	12.168	3.808	12.190	3.783	-0.005
	17a	12.055	3.944	11.985	3.930	0.016
	17b	11.840	3.950	11.828	3.901	0.003
VE	15c	38.707	7.588	38.970	7.485	-0.025
	15a	39.115	8.330	39.513	8.106	-0.038
	15b	39.341	7.805	39.464	7.850	-0.012
	16a	39.723	7.926	39.887	7.907	-0.015
	16b	39.727	7.615	39.633	7.540	0.009
	17a	40.173	7.925	40.283	7.958	-0.010
	17b	39.634	7.821	39.715	7.596	-0.008

Table 10

**Chi-Square Tests of ASVAB Form Effects for NO and CS Tests,
by Type of Answer Sheet**

Test	Comparison of forms	Vertical-Response Answer Sheet		Circular-Response Answer Sheet	
		Chi- Square	d.f.	Chi- Square	d.f.
NO	15a-15c	75.001*	9	53.264*	10
	15b-15c	10.722	9	17.795	9
	16a-15c	67.932*	10	30.649*	9
	16b-15c	15.181	10	19.873	9
	17a-15c	19.820	9	19.088	10
	17b-15c	22.991*	9	8.453	9
CS	15a-15c	15.816	8	17.556	8
	15b-15c	15.320	5	6.034	10
	16a-15c	14.988	7	18.765	10
	16b-15c	17.252	10	14.255	8
	17a-15c	38.320*	10	30.105*	10
	17b-15c	18.066	8	9.144	10

*Chi-square statistically significant with $\alpha = .05/6 = .00833$

Table 11

**ASVAB Form Effect Size* Estimates for NO and CS Tests,
by Type of Answer Sheet**

Test	Comparison of Forms	Vertical-Response Answer Sheet	Circular-Response Answer Sheet	Difference
NO	15a-15c	-.113	-.085	-.028
	15b-15c	-.026	-.044	.017
	16a-15c	.087	.063	.024
	16b-15c	-.012	-.030	.018
	17a-15c	.022	.032	-.009
	17b-15c	-.010	-.007	-.003
CS	15a-15c	.013	.022	-.009
	15b-15c	.040	.015	.026
	16a-15c	.011	-.033	.045
	16b-15c	.039	-.001	.041
	17a-15c	.072	.049	.023
	17b-15c	.037	.002	.035

*Mean number-right on operational form minus mean number right on reference form, divided by standard deviation in reference population (from Table 1).

Table 12

Indices for Selecting Equating Functions, for NO and CS

Root Mean Square Difference			
Score Metric: Difference Between Smooth Equating And Raw Equipercntile Equating			
	Linear Rescaling	Quartic Log-Linear	Polynomial Log-Linear
NO	1.3297	0.2493	0.0543
CS	0.1467	0.0842	0.0750
Frequency Metric: Difference between Cumulative Distributions of Equated Scores on Circular-Response and Scores on Vertical-Response Answer Sheets			
	Quartic Log-Linear	Polynomial Log-Linear	
NO	0.0093	0.0017	
CS	0.0024	0.0020	

Impact of Difference		
Score Metric: Percentage of Subjects for Which Equatings Differ by More Than .5 Standard Score Points		
Quartic versus Polynomial Log-Linear Equating		
NO	1.2601%	
CS	0.0000%	
Frequency Metric: Percentage of Subjects at Score Levels Where Cumulative Distributions of Vertical-Response and Equated Circular-Response Answer Sheets Differ by More Than .01		
	Quartic Log-Linear	Polynomial Log-Linear
NO	34.5163%	0.0000%
CS	0.0000%	0.0000%

*Root mean square difference in standard score metric, after weighting by relative frequencies of scores on the circular-response answer sheet.

**Root mean square difference in cumulative frequency metric, after weighting by relative frequencies of scores on the vertical-response answer sheet.

Table 13

**Statistics and Number of Terms in Polynomial Log-Linear Smoothing of Distributions
Used for Equating, for NO and CS**

	NO		CS	
	Vertical- Response Answer <u>Sheet</u>	Circular- Response Answer <u>Sheet</u>	Vertical- Response Answer <u>Sheet</u>	Circular- Response Answer <u>Sheet</u>
Pooled ASVAB forms	15b & 15c	15b & 15c	15a & 15c	15a & 15c
N	11,735	12,145	11,682	12,294
Mean	40.708	37.302	52.550	51.569
Standard Deviation	8.407	8.642	12.891	12.657
Skewness	-0.995	-0.477	-0.255	-0.189
Kurtosis	3.771	2.963	3.449	3.424
Number of Terms	9	9	8	8

Table 14

**Statistics for NO and CS Distributions after Calibration of the Circular-Response Answer Sheet,
by ASVAB Form**

<u>Moments of NO Distribution After Answer Sheet Calibration*</u>					
Form	Ans. Sht. Sample	Mean	Std.Dev.	Skewness	Kurtosis
15c	Vert. 5966	40.847804	8.282595	-0.984823	3.703327
	Circ. 6295	40.898254	8.418925	-1.017594	3.821388
15a	Vert. 5716	39.624213	8.832046	-0.855951	3.459383
	Circ. 5999	39.980035	8.703951	-0.842698	3.376131
15b	Vert. 5769	40.562489	8.532114	-1.001022	3.820560
	Circ. 5850	40.500504	8.422954	-1.004726	3.950396
16a	Vert. 5777	41.787260	7.875629	-1.092343	3.840394
	Circ. 5752	41.561448	8.169127	-1.135135	4.257912
16b	Vert. 5525	40.717466	8.384795	-1.027055	4.077722
	Circ. 5681	40.651841	8.324947	-0.953340	3.699561
17a	Vert. 5366	41.089266	8.200459	-1.077735	4.098787
	Circ. 5241	41.277199	8.260193	-1.130641	4.213612
17b	Vert. 4633	40.738398	8.488828	-1.070879	4.153202
	Circ. 4600	40.862040	8.367518	-1.024402	3.816008
<u>Moments of CS Distribution After Answer Sheet Calibration*</u>					
Form	Ans. Sht. Sample	Mean	Std.Dev.	Skewness	Kurtosis
15c	Vert. 5966	52.445692	12.865872	-0.297092	3.520556
	Circ. 6295	52.367424	12.920516	-0.328574	3.596520
15a	Vert. 5716	52.658677	12.915990	-0.211679	3.372457
	Circ. 5999	52.737882	12.848027	-0.184506	3.259826
15b	Vert. 5769	53.117871	13.152715	-0.222639	3.339918
	Circ. 5850	52.612553	12.966241	-0.269202	3.513337
16a	Vert. 5777	52.636316	12.871308	-0.142433	3.235653
	Circ. 5752	51.802543	12.674379	-0.185403	3.321618
16b	Vert. 5525	53.103710	12.629231	-0.262859	3.418773
	Circ. 5681	52.356680	12.366386	-0.306875	3.517416
17a	Vert. 5366	53.658591	12.526562	-0.262009	3.553583
	Circ. 5241	53.209111	12.484312	-0.349376	3.756717
17b	Vert. 4633	53.072955	12.967303	-0.394564	3.821899
	Circ. 4600	52.413181	12.640960	-0.325670	3.550913

*Moments for vertical answer sheet not affected by calibration.

Table 15

**NO and CS Means, Standard Deviations and Answer-Sheet Effect Size Estimates
After Calibration, by ASVAB Form**

		Answer Sheet					
		Vertical-Response		Circular-Response		Effect Size	
ASVAB							
<u>Form</u>	<u>Test</u>	<u>Mean</u>	<u>St.Dev.</u>	<u>Mean</u>	<u>St.Dev.</u>	<u>After</u>	<u>Before</u>
						<u>Calibration</u>	
NO							
15c		40.848	8.283	40.898	8.419	-0.005	(0.307)
15a		39.624	8.832	39.980	8.704	-0.033*	(0.279)
15b		40.562	8.532	40.501	8.423	+0.006	(0.325)
16a		41.787	7.876	41.561	8.169	+0.021	(0.331)
16b		40.717	8.385	40.652	8.325	+0.006	(0.325)
17a		41.089	8.200	41.277	8.260	-0.017	(0.298)
17b		40.738	8.489	40.862	8.368	-0.011	(0.304)
CS							
15c		52.446	12.866	52.367	12.921	+0.005	(0.063)
15a		52.659	12.916	52.738	12.848	-0.005	(0.054)
15b		53.118	13.153	52.613	12.966	+0.030*	(0.089)
16a		52.636	12.871	51.803	12.674	+0.050**	(0.108)
16b		53.104	12.629	52.357	12.366	+0.045**	(0.104)
17a		53.659	12.527	53.209	12.484	+0.027	(0.086)
17b		53.073	12.967	52.413	12.641	+0.039*	(0.098)

* $p < 0.05$ two-tailed t-test

** $p < 0.01$ two-tailed t-test

Table 16

**Distribution Frequencies, Number-Right Equivalents, and Unrounded Standard Score Equivalents of
NO Number-Right on the Circular-Response Answer Sheet**

<u>Number Right</u>	<u>Frequencies Vertical-Resp. Answer Sheet</u>	<u>Circular-Resp. Answer Sheet</u>	<u>Number Right Equiv.</u>	<u>Unrounded Standard Score Equivalents</u>
0	4	7	0.063020	15.580574
1	0	2	1.090843	16.532262
2	2	3	3.184964	18.471263
4	2	0	2.136325	17.500301
3	1	4	4.234682	19.443224
5	1	2	5.284895	20.415644
6	2	4	6.335374	21.388309
7	5	3	7.386015	22.361125
8	4	3	8.436760	23.334037
9	6	9	9.487576	24.307015
10	10	7	10.533640	25.275593
11	15	18	11.566560	26.232000
12	12	13	12.509800	27.105370
13	14	13	13.533940	28.053648
14	23	28	14.627280	29.066000
15	20	28	15.782240	30.135407
16	19	28	16.984980	31.249056
17	21	39	18.218540	32.391241
18	29	47	19.466740	33.546981
19	38	48	20.680080	34.670444
20	37	81	21.883470	35.784694
21	50	113	23.082770	36.895157
22	73	119	24.280500	38.004167
23	70	134	25.479890	39.114713
24	86	153	26.658380	40.205907
25	119	196	27.842340	41.302167
26	109	230	29.033780	42.405352
27	168	251	30.229730	43.512713
28	154	340	31.425580	44.619981
29	167	338	32.604900	45.711944
30	181	358	33.769750	46.790509
31	259	418	34.925160	47.860333
32	273	446	36.070850	48.921157
33	310	482	37.208880	49.974889
34	323	504	38.342940	51.024944
35	339	529	39.477150	52.075139
36	385	484	40.613100	53.126944
37	383	558	41.751100	54.180648
38	452	507	42.877870	55.223954
39	390	489	43.966490	56.231935
40	417	474	44.979150	57.169583

(continued)

Table 16
(continued)

**Distribution Frequencies, Number-Right Equivalents, and Unrounded Standard Score Equivalents of
NO Number-Right on Circular-Response Answer Sheet**

<u>Number Right</u>	<u>Frequencies Vertical-Resp. Answer Sheet</u>	<u>Frequencies Circular-Resp. Answer Sheet</u>	<u>Number Right Equiv.</u>	<u>Unrounded Standard Score Equivalents</u>
41	434	430	45.879860	58.003574
42	509	455	46.657130	58.723269
43	452	381	47.303700	59.321944
44	455	366	47.830080	59.809333
45	497	363	48.299960	60.244407
46	504	399	48.697790	60.612769
47	560	349	49.061000	60.949074
48	713	481	49.470930	61.328639
49	1128	626	49.814150	61.646435
50	1510	785	50.249990	62.049991

Table 17

**Distribution Frequencies, Number-Right Equivalents, and Unrounded Standard Score Equivalents of
CS Number-Right on the Circular-Response Answer Sheet**

<u>Number Right</u>	<u>Frequencies Vertical-Resp. Answer Sheet</u>	<u>Frequencies Circular-Resp. Answer Sheet</u>	<u>Number Right Equiv.</u>	<u>Unrounded Standard Score Equivalents</u>
0	7	4	-0.044789	21.573830
1	0	1	0.889288	22.131055
2	1	0	1.817824	22.684975
3	2	3	2.745844	23.238587
4	3	2	3.673697	23.792100
5	2	2	4.601474	24.345567
6	2	4	5.529211	24.899010
7	3	4	6.455430	25.451548
8	2	3	7.381129	26.003776
9	5	8	8.307269	26.556266
10	6	5	9.233715	27.108939
11	7	1	10.160380	27.661743
12	10	5	11.151970	28.253278
13	11	8	12.209710	28.884275
14	14	16	13.282120	29.524023
15	10	14	14.363940	30.169385
16	6	18	15.452420	30.818720
17	14	18	16.539740	31.467363
18	18	15	17.622590	32.113339
19	16	16	18.704990	32.759047
20	20	26	19.785840	33.403830
21	20	23	20.864360	34.047223
22	26	27	21.939980	34.688886
23	20	34	23.012360	35.328617
24	50	38	24.081320	35.966307
25	30	35	25.146810	36.601927
26	34	40	26.208860	37.235495
27	49	42	27.267580	37.867076
28	57	56	28.323110	38.496755
29	55	70	29.375640	39.124644
30	61	69	30.425360	39.750856
31	74	79	31.472450	40.375500
32	81	94	32.515030	40.997453
33	89	119	33.552500	41.616357
34	97	113	34.588480	42.234373
35	108	124	35.623110	42.851584
36	153	173	36.656540	43.468079
37	139	166	37.688880	44.083923
38	178	228	38.720250	44.699189
39	163	238	39.750740	45.313929
40	222	228	40.780420	45.928187
41	269	241	41.809370	46.542009
42	230	295	42.837650	47.155432

(continued)

Table 17
(continued)

**Distribution Frequencies, Number-Right Equivalents, and Unrounded Standard Score Equivalents of
CS Number-Right on the Circular-Response Answer Sheet**

<u>Number Right</u>	<u>Frequencies Vertical-Resp. Answer Sheet</u>	<u>Circular-Resp. Answer Sheet</u>	<u>Number Right Equiv.</u>	<u>Unrounded Standard Score Equivalents</u>
43	245	277	43.865290	47.768472
44	273	340	44.892340	48.381161
45	279	377	45.918820	48.993510
46	361	406	46.944750	49.605530
47	285	351	47.970140	50.217228
48	365	374	48.994990	50.828605
49	411	427	50.019310	51.439665
50	383	395	51.043060	52.050385
51	366	408	52.066240	52.660765
52	390	418	53.088810	53.270781
53	370	402	54.110720	53.880403
54	378	385	55.131930	54.489608
55	408	403	56.152370	55.098354
56	448	464	57.171970	55.706598
57	323	351	58.190620	56.314275
58	335	346	59.208210	56.921321
59	357	326	60.224620	57.527662
60	308	277	61.239680	58.133198
61	280	273	62.253210	58.737821
62	255	285	63.264990	59.341401
63	247	254	64.274780	59.943793
64	239	232	65.282260	60.544807
65	254	218	66.287110	61.144252
66	207	218	67.288930	61.741890
67	189	182	68.287260	62.337446
68	173	140	69.281590	62.930615
69	142	140	70.271340	63.521052
70	156	125	71.255830	64.108352
71	112	96	72.234360	64.692096
72	102	99	73.206100	65.271789
73	84	102	74.170190	65.846919
74	79	84	75.125710	66.416936
75	65	52	76.071710	66.981274
76	67	37	77.007230	67.539360
77	59	48	77.931340	68.090640
78	58	45	78.843220	68.634624
79	51	34	79.742190	69.170906
80	40	32	80.627820	69.699230
81	41	35	81.500030	70.219549
82	30	38	82.372480	70.740011
83	42	41	83.232720	71.253189
84	61	52	84.081740	71.75

Table 18

ASVAB Forms 8f/8g/9f/9g/10f/10g/13h/14f/14g/14h/15h/18h
Conversion of Raw Test Scores to 1980 Standard Score Equivalents

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	22	0	45					60	49	45
1	20	27	20	20	20	22	1	46					61	50	46
2	22	28	20	23	20	23	2	47					61	50	47
3	24	30	20	26	20	23	3	48					61	51	48
4	26	31	21	29	20	24	4	49					62	51	49
5	28	32	22	32	20	24	5	50					62	52	50
6	30	34	24	35	21	25	6	51						53	51
7	32	35	25	38	22	25	7	52						53	52
8	34	36	26	41	23	26	8	53						54	53
9	36	38	28	44	24	27	9	54						54	54
10	38	39	29	47	25	27	10	55						55	55
11	40	40	30	50	26	28	11	56						56	56
12	42	42	31	53	27	28	12	57						56	57
13	44	43	33	56	28	29	13	58						57	58
14	46	45	34	59	29	30	14	59						58	59
15	48	46	35	62	30	30	15	60						58	60
16	50	47	37		31	31	16	61						59	61
17	52	49	38		32	31	17	62						59	62
18	54	50	39		34	32	18	63						60	63
19	56	51	41		35	33	19	64						61	64
20	58	53	42		36	33	20	65						61	65
21	60	54	43		37	34	21	66						62	66
22	62	55	44		38	35	22	67						62	67
23	64	57	46		39	35	23	68						63	68
24	66	58	47		40	36	24	69						64	69
25	68	59	48		41	37	25	70						64	70
26		61	50		42	37	26	71						65	71
27		62	51		44	38	27	72						65	72
28		64	52		45	38	28	73						66	73
29		65	54		46	39	29	74						66	74
30		66	55		47	40	30	75						67	75
31			56		48	40	31	76						68	76
32			57		49	41	32	77						68	77
33			59		50	42	33	78						69	78
34			60		51	42	34	79						69	79
35			61		52	43	35	80						70	80
36					53	43	36	81						70	81
37					54	44	37	82						71	82
38					55	45	38	83						71	83
39					56	45	39	84						72	84
40					57	46	40	85							85
41					58	47	41	86							86
42					59	47	42	87							87
43					59	48	43	88							88
44					60	48	44	89							89

(continued)

Table 18
(continued)

ASVAB Forms 8f/8g/9f/9g/10f/10g/13h/14f/14g/14h/15h/18h
Conversion of Raw Test Scores to 1980 Standard Score Equivalents

Raw	AS	MK	MC	EI	VE	Raw		Raw	AS	MK	MC	EI	VE	Raw
0	24	29	24	23	20	0		25	69	68	70		38	25
1	26	30	25	25	20	1		26					39	26
2	28	32	27	27	20	2		27					40	27
3	30	33	29	30	20	3		28					41	28
4	31	35	31	32	20	4		29					42	29
5	33	37	33	34	20	5		30					43	30
6	35	38	35	37	20	6		31					44	31
7	37	40	37	39	21	7		32					45	32
8	39	41	38	42	22	8		33					46	33
9	40	43	40	44	23	9		34					47	34
10	42	44	42	46	24	10		35					48	35
11	44	46	44	49	25	11		36					49	36
12	46	48	46	51	26	12		37					50	37
13	48	49	48	53	27	13		38					51	38
14	49	51	50	56	28	14		39					52	39
15	51	52	52	58	29	15		40					53	40
16	53	54	53	60	30	16		41					54	41
17	55	55	55	63	31	17		42					54	42
18	57	57	57	65	32	18		43					55	43
19	58	58	59	68	33	19		44					56	44
20	60	60	61	70	34	20		45					57	45
21	62	62	63		35	21		46					58	46
22	64	63	65		36	22		47					59	47
23	66	65	67		37	23		48					60	48
24	67	66	68		37	24		49					61	49
								50					62	50

Table 19**Correspondence of ASVAB Test Booklets with Form Designations under
Vertical-Response and Circular-Response Answer Sheets**

Current Test Booklets	Vertical-Response Answer Sheet	Circular-Response Answer Sheet
8a*/b	8a/b	8f/g
9a/b	9a/b	9f/g
10a/b	10a/b	10f/g
11a/b	11a/b	11f/g
12a/b	12a/b	12f/g
13a/b/c*	13a/b/c	13f/g/h
14a/b/c	14a/b/c	14f/g/h
15a/b/c*	15a/b/c	15f/g/h
16a/b	16a/b	16f/g
17a/b	17a/b	17f/g
18a/b/c*	18a/b/c	18f/g/h
19a/b	19a/b	19f/g
20a/b	n.a	20a/b
21a/b	n.a.	21a/b
22a/b	n.a.	22a/b

*ASVAB forms 8a, 13c, 15c, and 18c have identical items, item layouts, and instructions.

Table 20

Order of Linking ASVAB Form Equatings and Circular-Response Answer-Sheet Equatings

Order and Type of Function in Linkage		
Equating Test Forms With Circular- Response OMR	OMR Calibration	Equating Test Forms With Vertical- Response OMR
O----->O $f_n(x)$	O-----> $g(x)$	-----> $f_o(x)$
If using:		
ASVAB 8/9/10/14 with Vert. OMR - no equating or calibration		x
ASVAB 8/9/10/14 with Circ. OMR - $g(x)$ only	x----->x.....x integer fraction	
ASVAB 11-13,15-19 with Vert. OMR - $f_o(x)$ only		x----->x integer fraction
ASVAB 11-13,15-17* with Circ. OMR - $f_o[g(x)]$	x----->x.....x----->x integer fraction fraction fraction	
ASVAB 18-19** with Circ. OMR - $f_o[g(x)]$	x----->x.....x----->x integer fraction fraction fraction interpolated	
ASVAB 20-22** with Circ. OMR - $g[f_n(x)]$	x----->x.....x----->x.....x integer fraction fraction fraction interpolated	

*ASVAB Forms 11-13 and 15-19 were equated to the reference form (ASVAB 8a) in IOT&E studies that used the vertical-response answer sheet. Therefore, the linkage to the OMR calibration is in a sequence that differs from the sequence to be used for ASVAB 20-22, for which the equating was done with the circular-response answer sheets.

**Second step in linkage required interpolation of fractional equivalents because the equating of these forms was not linear.

Table 21

**Means, Standard Deviations and Linear Equatings for NO and CS from IOT&E's
of ASVAB 11/12/13 and ASVAB 15/16/17**

<u>NO</u>	<u>N</u>	<u>Mean</u>	<u>St.Dev.</u>	<u>Linear Equating</u>
<u>Form(s)</u> 11a/b, 12b & 13a/b	84838	n.a.*	n.a.	.9992 x + 1.6279
12a	18377	34.689**	8.974	.9746 x + 4.7718
15a	14963	38.8567	8.9045	.9641 x + 2.1129
15b	14399	39.1890	8.7044	.9862 x + .9240
15c	14207	39.5732	8.5845	x
16a	14287	40.5210	8.3005	1.0342 x - 2.3342
16b	13822	39.5944	8.3949	1.0226 x - .9154
17a	13571	39.7565	8.5045	1.0094 x - .5572
17b	13010	39.6275	8.4828	1.0120 x - .5294
<u>CS</u>	<u>N</u>	<u>Mean</u>	<u>St.Dev.</u>	<u>Linear Equating</u>
<u>Form(s)</u> 11a/b, 12b & 13a/b	84838	n.a.	n.a.	.9829 x - .1254
12a	18377	50.047	13.233	.9664 x + .7405
15a/b	29362	50.9602	13.1928	.9921 x - .1618
15c	14207	50.3974	13.0890	x
16a/b	28109	50.7056	12.8907	1.0154 x - 1.0882
17a/b	26581	51.2578	12.9073	1.0141 x - 1.5820

*Equating was the average of separate linear equatings of the five forms.

**Data available from the IOT&E of ASVAB 11/12/13 consisted of sample sizes, means and variances, with the latter two statistics provided to three decimal places.

Table 22

Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for NO
on ASVAB 11/12/13 and ASVAB 15/16/17

	<u>Raw</u>	<u>11a</u>	<u>12b</u>	<u>13a</u>	<u>12a</u>	<u>15a</u>	<u>15b</u>	<u>16a</u>	<u>16b</u>	<u>17a</u>	<u>17b</u>
0	17.08784	19.99742	17.53487	16.43532	13.42127	14.73430	15.06520	15.09109			
1	18.03877	20.92494	18.45239	17.37388	14.40551	15.70750	16.02583	16.05420			
2	19.00603	21.86839	19.38568	18.32856	15.40666	16.69741	17.00297	17.03385			
3	19.97622	22.81469	20.32178	19.28612	16.41082	17.69032	17.98306	18.01647			
4	20.94740	23.76196	21.25885	20.24467	17.41603	18.68425	18.96416	19.00009			
5	21.91904	24.70968	22.19636	21.20367	18.42170	19.67864	19.94572	19.98418			
6	22.89093	25.65764	23.13411	22.16291	19.42763	20.67329	20.92752	20.96852			
7	23.86297	26.60575	24.07200	23.12230	20.43372	21.66809	21.90949	21.95301			
8	24.83510	27.55395	25.00998	24.08179	21.43990	22.66299	22.89154	22.93759			
9	25.80730	28.50221	25.94803	25.04134	22.44616	23.65796	23.87367	23.92225			
10	26.77510	29.44619	26.88183	25.99655	23.44786	24.64843	24.85135	24.90245			
11	27.73075	30.37831	27.80391	26.93976	24.43698	25.62645	25.81675	25.87033			
12	28.60342	31.22949	28.64592	27.80108	25.34022	26.51956	26.69833	26.75418			
13	29.55094	32.15368	29.56016	28.73627	26.32093	27.48927	27.65552	27.71384			
14	30.56248	33.14032	30.53617	29.73465	27.36790	28.52450	28.67739	28.73834			
15	31.63103	34.18257	31.56718	30.78930	28.47388	29.61807	29.75684	29.82058			
16	32.74379	35.26793	32.64085	31.88758	29.62562	30.75689	30.88096	30.94759			
17	33.88506	36.38110	33.74203	33.01400	30.80686	31.92489	32.03388	32.10348			
18	35.03988	37.50749	34.85628	34.15380	32.00213	33.10675	33.20049	33.27309			
19	36.16244	38.60241	35.93941	35.26176	33.16402	34.25560	34.33451	34.41004			
20	37.27580	39.68836	37.01366	36.36063	34.31638	35.39503	35.45924	35.53766			
21	38.38537	40.77062	38.08426	37.45577	35.46482	36.53059	36.58014	36.66145			
22	39.49350	41.85146	39.15345	38.54947	36.61175	37.66467	37.69957	37.78377			
23	40.60315	42.93380	40.22413	39.64469	37.76028	38.80031	38.82056	38.90764			
24	41.69347	43.99728	41.27615	40.72083	38.88879	39.91617	39.92201	40.01193			
25	42.78886	45.06569	42.33306	41.80196	40.02254	41.03720	41.02857	41.12134			
26	43.89116	46.14085	43.39664	42.88992	41.16346	42.16532	42.14213	42.23776			
27	44.99764	47.22009	44.46424	43.98200	42.30869	43.29771	43.25990	43.35841			
28	46.10402	48.29923	45.53176	45.07399	43.45383	44.43000	44.37757	44.47897			
29	47.19511	49.36346	46.58452	46.15088	44.58314	45.54664	45.47980	45.58404			
30	48.27281	50.41463	47.62437	47.21456	45.69859	46.64958	46.56851	46.67554			
31	49.34178	51.45728	48.65578	48.26962	46.80500	47.74358	47.64839	47.75820			
32	50.40175	52.49116	49.67853	49.31581	47.90210	48.82838	48.71918	48.83176			
33	51.45464	53.51812	50.69443	50.35500	48.99187	49.90593	49.78282	49.89814			
34	52.50386	54.54151	51.70679	51.39056	50.07784	50.97971	50.84274	50.96079			
35	53.55321	55.56503	52.71928	52.42626	51.16395	52.05364	51.90281	52.02359			
36	54.60417	56.59012	53.73332	53.46355	52.25173	53.12922	52.96450	53.08802			
37	55.65704	57.61706	54.74920	54.50272	53.34147	54.20674	54.02811	54.15436			
38	56.69951	58.63386	55.75505	55.53162	54.42046	55.27362	55.08122	55.21019			
39	57.70668	59.61624	56.72684	56.52570	55.46291	56.30438	56.09868	56.23027			
40	58.64358	60.53007	57.63083	57.45041	56.43263	57.26322	57.04514	57.17917			

(continued)

Table 22
(continued)

**Circular-Response Answer-Sheet Unrounded Standard Score Equivalents
for NO on ASVAB 11/12/13 and ASVAB 15/16/17**

<u>Raw</u>	<u>11a</u>	<u>12b</u>	<u>13a</u>	<u>12a</u>	<u>15a</u>	<u>15b</u>	<u>16a</u>	<u>16b</u>	<u>17a</u>	<u>17b</u>
41	59.47690	61.34288	58.43488	58.27289	57.29514	58.11606	57.88697	58.02316		
42	60.19602	62.04429	59.12874	58.98265	58.03945	58.85202	58.61343	58.75150		
43	60.79422	62.62776	59.70592	59.57306	58.65860	59.46423	59.21774	59.35736		
44	61.28122	63.10277	60.17582	60.05373	59.16266	59.96263	59.70971	59.85059		
45	61.71594	63.52680	60.59527	60.48280	59.61261	60.40754	60.14887	60.29089		
46	62.08401	63.88580	60.95041	60.84607	59.99357	60.78422	60.52069	60.66367		
47	62.42005	64.21357	61.27464	61.17774	60.34138	61.12813	60.86016	61.00401		
48	62.79931	64.58349	61.64058	61.55207	60.73392	61.51627	61.24329	61.38813		
49	63.11685	64.89321	61.94696	61.86548	61.06259	61.84125	61.56408	61.70974		
50	63.28880	65.06093	62.11287	62.03518	61.24056	62.01722	61.73778	61.88389		

Table 23

**Circular-Response Answer-Sheet Unrounded Standard Score Equivalents
for NO on ASVAB 18/19 and ASVAB 20/21/22**

<u>Raw</u>	<u>18ab</u>	<u>19ab</u>	<u>20ab</u>	<u>21ab</u>	<u>22ab</u>
0	15.81302	15.77399	15.53977	15.70446	15.53068
1	16.98967	16.93024	16.48848	16.68039	16.47873
2	18.12891	18.06548	17.43987	17.70190	17.42642
3	19.30813	19.21223	18.39203	18.73507	18.37439
4	20.51006	20.38036	19.34427	19.77249	19.32225
5	21.72066	21.56016	20.29654	20.81190	20.27002
6	22.91567	22.73987	21.24880	21.85240	21.21774
7	24.05354	23.87164	22.20106	22.88067	22.16543
8	25.10577	24.94135	23.15332	23.90609	23.11310
9	26.10940	26.02885	24.10558	24.93170	24.06075
10	27.10563	27.13590	25.05441	25.94920	25.00518
11	28.09707	28.23890	25.99316	26.90057	25.94000
12	29.00430	29.25521	26.86858	27.89068	26.81587
13	29.98827	30.35975	27.77624	28.95661	27.71449
14	31.03667	31.52430	28.74814	30.08912	28.67739
15	32.14407	32.73360	29.77669	31.29603	29.69684
16	33.30206	33.96648	31.00534	32.47007	30.90345
17	34.50323	35.19224	32.42171	33.58893	32.31154
18	35.73620	36.39775	33.75915	34.66622	33.64815
19	36.95276	37.54059	34.99497	35.72893	34.88285
20	38.16397	38.65110	36.17470	36.78599	36.06099
21	39.37698	39.73987	37.31883	37.84164	37.20258
22	40.58981	40.81454	38.44112	38.89971	38.32072
23	41.79368	41.88298	39.54310	39.94536	39.41911
24	42.95415	42.92803	40.62746	40.99339	40.49498
25	44.08723	43.97527	41.71374	42.05018	41.56977
26	45.18745	45.02811	42.80519	43.11476	42.64681
27	46.24965	46.08548	43.90114	44.18423	43.72521
28	47.28367	47.14470	44.99582	45.24896	44.80076
29	48.28994	48.19273	46.08195	46.30507	45.86306
30	49.28688	49.23337	47.16403	47.35646	46.91530
31	50.29526	50.27399	48.24676	48.40594	47.96240
32	51.33334	51.31949	49.33249	49.45545	49.00532
33	52.41877	52.37796	50.42583	50.50888	50.04716
34	53.56115	53.45736	51.53270	51.57124	51.09261
35	54.75921	54.56246	52.65894	52.64649	52.14673
36	55.98198	55.68326	53.80831	53.73647	53.21251
37	57.16091	56.78742	54.97166	54.83372	54.29033
38	58.19527	57.81161	56.11836	55.91393	55.36581
39	59.01683	58.69488	57.19337	56.93624	56.40832
40	59.65311	59.40930	58.12763	57.85397	57.37484

(continued)

Table 23
(continued)

**Circular-Response Answer-Sheet Unrounded Standard Score Equivalents
for NO on ASVAB 18/19 and ASVAB 20/21/22**

<u>Raw</u>	<u>18ab</u>	<u>19ab</u>	<u>20ab</u>	<u>21ab</u>	<u>22ab</u>
41	60.13302	59.93536	58.90601	58.64076	58.22795
42	60.51266	60.37093	59.52175	59.28338	58.95066
43	60.82526	60.71191	60.01278	59.79007	59.53769
44	61.08139	60.97214	60.41425	60.22265	60.02275
45	61.30191	61.20435	60.74034	60.57500	60.43283
46	61.48472	61.40090	61.03336	60.88256	60.78087
47	61.65028	61.57914	61.32941	61.20386	61.11815
48	61.82962	61.77354	61.56589	61.49364	61.43961
49	61.97978	63.16726	61.84168	61.77191	61.73432
50	62.06108	63.16726	62.11354	62.09107	62.07968

Table 24

**Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for CS
on ASVAB 11/12/13 and ASVAB 15/16/17**

<u>Raw</u>	<u>11ab12b13ab</u>	<u>12a</u>	<u>15ab</u>	<u>16ab</u>	<u>17ab</u>
0	21.52574	22.04230	21.50403	20.95138	20.65680
1	22.04718	22.55498	22.03034	21.49006	21.19479
2	22.59162	23.09029	22.57989	22.05251	21.75652
3	23.13577	23.62530	23.12912	22.61464	22.31794
4	23.67982	24.16021	23.67826	23.17668	22.87926
5	24.22382	24.69508	24.22736	23.73867	23.44053
6	24.76780	25.22993	24.77643	24.30064	24.00177
7	25.31089	25.76390	25.32460	24.86169	24.56210
8	25.85367	26.29757	25.87247	25.42242	25.12212
9	26.39672	26.83150	26.42059	25.98342	25.68240
10	26.93994	27.36560	26.96890	26.54460	26.24286
11	27.48329	27.89983	27.51734	27.10592	26.80346
12	28.06471	28.47149	28.10420	27.70656	27.40334
13	28.68492	29.08129	28.73021	28.34728	28.04323
14	29.31372	29.69954	29.36491	28.99688	28.69200
15	29.94805	30.32322	30.00517	29.65218	29.34646
16	30.58628	30.95074	30.64937	30.31151	30.00495
17	31.22383	31.57758	31.29289	30.97014	30.66274
18	31.85876	32.20186	31.93377	31.62607	31.31782
19	32.49343	32.82587	32.57437	32.28172	31.97264
20	33.12719	33.44899	33.21406	32.93643	32.62651
21	33.75958	34.07076	33.85237	33.58973	33.27898
22	34.39027	34.69087	34.48897	34.24128	33.92969
23	35.01906	35.30910	35.12364	34.89086	34.57844
24	35.64585	35.92536	35.75630	35.53837	35.22512
25	36.27060	36.53963	36.38689	36.18378	35.86970
26	36.89333	37.15191	37.01546	36.82711	36.51220
27	37.51411	37.76227	37.64205	37.46841	37.15269
28	38.13302	38.37079	38.26675	38.10779	37.79125
29	38.75017	38.97758	38.88968	38.74535	38.42799
30	39.36568	39.58275	39.51095	39.38120	39.06303
31	39.97964	40.18641	40.13065	40.01547	39.69648
32	40.59096	40.78746	40.74770	40.64700	40.32720
33	41.19928	41.38557	41.36171	41.27543	40.95484
34	41.80673	41.98282	41.97484	41.90297	41.58156
35	42.41338	42.57930	42.58718	42.52968	42.20748
36	43.01934	43.17508	43.19880	43.15567	42.83267
37	43.62465	43.77023	43.80978	43.78100	43.45719
38	44.22939	44.36482	44.42019	44.40574	44.08113
39	44.83362	44.95891	45.03007	45.02995	44.70454
40	45.43738	45.55253	45.63948	45.65366	45.32746

(continued)

Table 24
(continued)

**Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for CS
on ASVAB 11/12/13 and ASVAB 15/16/17**

<u>Raw</u>	<u>11ab12b13ab</u>	<u>12a</u>	<u>15ab</u>	<u>16ab</u>	<u>17ab</u>
41	46.04070	46.14572	46.24845	46.27694	45.94994
42	46.64364	46.73853	46.85703	46.89981	46.57201
43	47.24619	47.33098	47.46522	47.52229	47.19369
44	47.84840	47.92308	48.07307	48.14442	47.81502
45	48.45028	48.51485	48.68058	48.76619	48.43601
46	49.05184	49.10631	49.28777	49.38764	49.05665
47	49.65308	49.69745	49.89464	50.00876	49.67698
48	50.25400	50.28829	50.50118	50.62955	50.29698
49	50.85461	50.87882	51.10741	51.25002	50.91665
50	51.45488	51.46902	51.71331	51.87014	51.53598
51	52.05483	52.05889	52.31887	52.48992	52.15497
52	52.65441	52.64841	52.92406	53.10934	52.77359
53	53.25361	53.23755	53.52887	53.72834	53.39180
54	53.85240	53.82628	54.13326	54.34693	54.00960
55	54.45073	54.41457	54.73720	54.96505	54.62693
56	55.04858	55.00238	55.34064	55.58266	55.24375
57	55.64586	55.58964	55.94351	56.19970	55.85999
58	56.24253	56.17629	56.54577	56.81609	56.47560
59	56.83850	56.76226	57.14732	57.43177	57.09049
60	57.43368	57.34745	57.74807	58.04663	57.70456
61	58.02797	57.93176	58.34792	58.66057	58.31771
62	58.62123	58.51505	58.94673	59.27344	58.92980
63	59.21332	59.09721	59.54436	59.88511	59.54069
64	59.80405	59.67803	60.14062	60.49538	60.15018
65	60.39325	60.25733	60.73533	61.10406	60.75807
66	60.98067	60.83489	61.32825	61.71090	61.36414
67	61.56604	61.41043	61.91910	62.31563	61.96809
68	62.14906	61.98367	62.50758	62.91793	62.56962
69	62.72940	62.55427	63.09336	63.51746	63.16839
70	63.30666	63.12184	63.67602	64.11380	63.76397
71	63.88042	63.68597	64.25515	64.70654	64.35594
72	64.45020	64.24618	64.83026	65.29516	64.94381
73	65.01550	64.80199	65.40085	65.87914	65.52705
74	65.57577	65.35285	65.96636	66.45794	66.10510
75	66.13046	65.89823	66.52624	67.03097	66.67740
76	66.67900	66.43756	67.07992	67.59765	67.24335
77	67.22085	66.97032	67.62685	68.15742	67.80240
78	67.75553	67.49603	68.16653	68.70978	68.35406
79	68.28265	68.01429	68.69858	69.25432	68.89790
80	68.80194	68.52486	69.22273	69.79078	69.43368
81	69.31336	69.02770	69.73894	70.31911	69.96133
82	69.82492	69.53067	70.25529	70.84759	70.48913
83	70.32932	70.02661	70.76441	71.36867	71.00955
84	70.77922	70.46895	71.21852	71.83344	71.47372

Table 25

**Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for CS
on ASVAB 18/19 and ASVAB 20/21/22**

<u>Raw</u>	<u>18ab</u>	<u>19a</u>	<u>19b</u>	<u>20ab</u>	<u>21ab</u>	<u>22ab</u>
0	21.62192	21.54451	21.76848	21.64272	21.63515	21.60957
1	21.62192	22.04753	21.76848	22.21454	22.20537	22.17437
2	22.73260	22.56009	23.03155	22.80105	22.78829	22.74520
3	23.30333	23.06882	23.69035	23.39181	23.37497	23.31808
4	23.87434	23.57645	24.35961	23.98413	23.96302	23.89173
5	24.44547	24.08361	25.03641	24.57718	24.55172	24.46573
6	25.01666	24.58649	25.71780	25.17019	25.14038	25.03971
7	25.58697	25.08506	26.40397	25.75386	25.72832	25.61301
8	26.15700	25.58376	27.12993	26.33821	26.30840	26.18625
9	26.76725	26.08688	27.92161	26.92439	26.89026	26.75981
10	27.46157	26.62075	28.75193	27.51192	27.47344	27.33358
11	28.16662	27.23443	29.61026	28.13116	28.08532	27.92468
12	28.92298	27.92468	30.51662	28.79559	28.74169	28.55785
13	29.72242	28.64375	31.45172	29.47696	29.41722	29.21546
14	30.51214	29.35972	32.35474	30.16569	30.10027	29.87936
15	31.28351	30.07335	33.20415	30.85947	30.78851	30.54869
16	32.03350	30.78259	33.99424	31.55262	31.47681	31.21974
17	32.75199	31.48258	34.71477	32.24354	32.16257	31.88904
18	33.43529	32.17185	35.36675	32.92833	32.84333	32.55594
19	34.08709	32.85393	35.96076	33.61355	33.50318	33.22566
20	34.70996	33.52921	36.50697	34.30714	34.15087	33.88752
21	35.30831	34.19843	37.01697	34.99426	34.79445	34.54409
22	35.88755	34.86246	37.50221	35.67037	35.43422	35.19560
23	36.45343	35.52220	37.96839	36.33898	36.07047	35.84235
24	37.01160	36.17847	38.41318	37.00303	36.70352	36.48471
25	37.56732	36.83196	38.85821	37.66294	37.33370	37.12304
26	38.12292	37.48299	39.30520	38.31915	37.96131	37.75774
27	38.67660	38.13168	39.74623	38.97207	38.58663	38.38914
28	39.23589	38.77789	40.19791	39.62208	39.20995	39.01761
29	39.80275	39.42105	40.66160	40.26950	39.83150	39.64348
30	40.37753	40.06025	41.13164	40.91361	40.45137	40.26702
31	40.95990	40.69554	41.60998	41.55402	41.06862	40.88748
32	41.54780	41.32574	42.10253	42.19284	41.68327	41.50453
33	42.13953	41.95006	42.60756	42.83055	42.29730	42.11998
34	42.73562	42.57035	43.12236	43.46739	42.91084	42.73437
35	43.33460	43.18642	43.64345	44.10351	43.52405	43.34789
36	43.93504	43.79823	44.17339	44.73909	44.13705	43.96068
37	44.53566	44.40580	44.71296	45.37429	44.74995	44.57290
38	45.13537	45.00930	45.26073	46.00924	45.36287	45.18467
39	45.73331	45.60844	45.81538	46.64405	45.97591	45.79610
40	46.32885	46.20316	46.37584	47.27882	46.58916	46.40731
41	46.92165	46.79452	46.94119	47.91367	47.20273	47.01841
42	47.51157	47.38328	47.51072	48.54866	47.81669	47.62947
43	48.09869	47.96995	48.08386	49.18389	48.43116	48.24060
44	48.68330	48.55503	48.65898	49.81941	49.04620	48.85190
45	49.26455	49.13901	49.23672	50.45529	49.66192	49.46344

(continued)

Table 25
(continued)

**Circular-Response Answer-Sheet Unrounded Standard Score Equivalents for CS
on ASVAB 18/19 and ASVAB 20/21/22**

<u>Raw</u>	<u>18ab</u>	<u>19a</u>	<u>19b</u>	<u>20ab</u>	<u>21ab</u>	<u>22ab</u>
46	49.84452	49.72229	49.81761	51.09157	50.27842	50.07532
47	50.42417	50.30520	50.40141	51.72830	50.89577	50.68763
48	51.00426	50.88802	50.98775	52.36556	51.51408	51.30045
49	51.58562	51.47095	51.57629	53.00368	52.13345	51.91388
50	52.16899	52.05402	52.16651	53.64274	52.75397	52.52802
51	52.75513	52.63724	52.75789	54.28272	53.37575	53.14295
52	53.34473	53.22049	53.34981	54.92353	53.99885	53.75875
53	53.93837	53.80356	53.94158	55.56510	54.62339	54.37553
54	54.53656	54.38617	54.53244	56.20725	55.24941	54.99336
55	55.13965	54.96795	55.12158	56.84976	55.87700	55.61230
56	55.74776	55.54848	55.70815	57.49234	56.50616	56.23243
57	56.36078	56.12729	56.29132	58.13459	57.13689	56.85375
58	56.97831	56.70388	56.87033	58.77596	57.76914	57.47628
59	57.59964	57.27776	57.44454	59.41585	58.40281	58.09997
60	58.22369	57.84868	58.01348	60.05351	59.03768	58.72472
61	58.84908	58.41725	58.57688	60.68797	59.67588	59.35035
62	59.47418	58.98344	59.13473	61.31812	60.31503	59.97656
63	60.09718	59.54577	59.68729	61.94265	60.95432	60.60299
64	60.71616	60.10394	60.23627	62.56005	61.59287	61.22912
65	61.32933	60.65765	60.78455	63.16866	62.22957	61.85426
66	61.93505	61.20655	61.33032	63.76663	62.86304	62.47755
67	62.53200	61.75020	61.87412	64.35202	63.49164	63.09790
68	63.11919	62.28793	62.41665	64.92286	64.11343	63.71403
69	63.69605	62.81882	62.95836	65.47722	64.72612	64.32441
70	64.26231	63.34155	63.49934	66.01338	65.32751	64.92732
71	64.81807	63.85454	64.03924	66.52994	65.91518	65.52084
72	65.36365	64.35823	64.57718	67.02598	66.48673	66.10298
73	65.89969	64.85693	65.11188	67.50077	67.03990	66.67166
74	66.42708	65.34233	65.64176	67.95439	67.57278	67.22495
75	66.94717	65.81311	66.16536	68.38874	68.08394	67.76110
76	67.46192	66.26899	66.68186	68.80736	68.57208	68.27875
77	67.97489	66.71168	67.19326	69.20978	69.03782	68.77708
78	68.49051	67.15103	67.70759	69.59705	69.48237	69.25593
79	69.01361	67.61084	68.22832	69.97404	69.90726	69.71593
80	69.54799	68.10427	68.77001	70.34410	70.31460	70.15753
81	70.09384	68.66904	69.36009	70.71259	70.71037	70.58923
82	70.65458	69.39551	70.03853	71.07980	71.09305	71.00955
83	71.69989	71.43709	71.56942	71.44908	71.46635	71.41555
84	71.69989	71.43709	71.56942	71.82045	71.82803	71.81204

Table 26

**ASVAB Forms 11f/11g/12g/13f/13g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	21	26	22	21	20	22	0	45					62	48	45
1	23	26	23	24	20	22	1	46					62	49	46
2	25	27	24	26	20	23	2	47					62	50	47
3	26	28	25	29	20	23	3	48					63	50	48
4	28	30	26	32	21	24	4	49					63	51	49
5	30	31	27	34	22	24	5	50					63	51	50
6	32	32	28	37	23	25	6	51						52	51
7	33	34	30	40	24	25	7	52						53	52
8	35	35	31	42	25	26	8	53						53	53
9	37	36	32	45	26	26	9	54						54	54
10	39	38	33	48	27	27	10	55						54	55
11	40	39	34	50	28	27	11	56						55	56
12	42	40	35	53	29	28	12	57						56	57
13	44	42	36	56	30	29	13	58						56	58
14	46	43	37	58	31	29	14	59						57	59
15	48	44	39	61	32	30	15	60						57	60
16	49	46	40		33	31	16	61						58	61
17	51	47	41		34	31	17	62						59	62
18	53	48	42		35	32	18	63						59	63
19	55	50	43		36	32	19	64						60	64
20	56	51	44		37	33	20	65						60	65
21	58	52	45		38	34	21	66						61	66
22	60	54	47		39	34	22	67						62	67
23	62	55	48		41	35	23	68						62	68
24	63	56	49		42	36	24	69						63	69
25	65	58	50		43	36	25	70						63	70
26		59	51		44	37	26	71						64	71
27		60	52		45	38	27	72						64	72
28		62	53		46	38	28	73						65	73
29		63	55		47	39	29	74						66	74
30		64	56		48	39	30	75						66	75
31			57		49	40	31	76						67	76
32			58		50	41	32	77						67	77
33			59		51	41	33	78						68	78
34			60		53	42	34	79						68	79
35			61		54	42	35	80						69	80
36					55	43	36	81						69	81
37					56	44	37	82						70	82
38					57	44	38	83						70	83
39					58	45	39	84						71	84
40					59	45	40	85							85
41					59	46	41	86							86
42					60	47	42	87							87
43					61	47	43	88							88
44					61	48	44	89							89

(continued)

Table 26
(continued)

ASVAB Forms 11f/11g/12g/13f/13g
Conversion of Raw Test Scores to 1980 Standard Score Equivalents

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	26	30	24	23	21	0	25	68	67	70			41	25
1	27	32	24	26	21	1	26						42	26
2	29	33	25	28	22	2	27						43	27
3	31	35	27	30	23	3	28						44	28
4	32	36	29	32	24	4	29						44	29
5	34	38	31	35	25	5	30						45	30
6	36	39	33	37	25	6	31						46	31
7	37	41	35	39	26	7	32						47	32
8	39	42	37	42	27	8	33						48	33
9	41	44	39	44	28	9	34						48	34
10	43	45	41	46	29	10	35						49	35
11	44	47	43	48	30	11	36						50	36
12	46	48	45	51	30	12	37						51	37
13	48	50	47	53	31	13	38						52	38
14	49	51	49	55	32	14	39						53	39
15	51	52	51	58	33	15	40						53	40
16	53	54	53	60	34	16	41						54	41
17	54	55	55	62	34	17	42						55	42
18	56	57	57	64	35	18	43						56	43
19	58	58	59	67	36	19	44						57	44
20	60	60	61	69	37	20	45						57	45
21	61	61	63		38	21	46						58	46
22	63	63	65		39	22	47						59	47
23	65	64	67		39	23	48						60	48
24	66	66	69		40	24	49						61	49
							50						62	50

Table 27

**ASVAB Form 12f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	22	0	45					64	49	45
1	20	26	20	20	21	23	1	46					64	49	46
2	21	28	20	24	22	23	2	47					64	50	47
3	23	29	21	28	23	24	3	48					65	50	48
4	25	30	23	32	24	24	4	49					65	51	49
5	28	32	25	36	25	25	5	50					65	51	50
6	30	33	26	39	26	25	6	51						52	51
7	32	34	28	42	27	26	7	52						53	52
8	34	36	30	45	28	26	8	53						53	53
9	36	37	31	48	29	27	9	54						54	54
10	38	38	33	51	29	27	10	55						54	55
11	40	39	34	53	30	28	11	56						55	56
12	42	41	36	55	31	28	12	57						56	57
13	43	42	37	58	32	29	13	58						56	58
14	45	43	38	59	33	30	14	59						57	59
15	47	44	39	61	34	30	15	60						57	60
16	48	45	40		35	31	16	61						58	61
17	50	47	42		36	32	17	62						59	62
18	52	48	43		38	32	18	63						59	63
19	54	49	44		39	33	19	64						60	64
20	56	50	45		40	33	20	65						60	65
21	58	52	46		41	34	21	66						61	66
22	60	53	47		42	35	22	67						61	67
23	62	55	48		43	35	23	68						62	68
24	64	56	49		44	36	24	69						63	69
25	67	57	50		45	37	25	70						63	70
26		59	51		46	37	26	71						64	71
27		61	52		47	38	27	72						64	72
28		62	53		48	38	28	73						65	73
29		64	54		49	39	29	74						65	74
30		66	55		50	40	30	75						66	75
31			57		51	40	31	76						66	76
32			58		52	41	32	77						67	77
33			59		54	41	33	78						67	78
34			60		55	42	34	79						68	79
35			61		56	43	35	80						69	80
36					57	43	36	81						69	81
37					58	44	37	82						70	82
38					59	44	38	83						70	83
39					60	45	39	84						70	84
40					61	46	40	85							85
41					61	46	41	86							86
42					62	47	42	87							87
43					63	47	43	88							88
44					63	48	44	89							89

(continued)

Table 27
(continued)

**ASVAB Form 12f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	27	30	24	23	20	0	25	69	68	70		42	25
1	28	32	26	24	20	1	26					43	26
2	30	34	28	26	20	2	27					44	27
3	32	36	29	29	20	3	28					45	28
4	34	37	31	31	20	4	29					46	29
5	36	39	33	34	21	5	30					46	30
6	37	40	34	36	22	6	31					47	31
7	39	42	36	38	23	7	32					48	32
8	41	43	38	41	24	8	33					49	33
9	42	45	39	43	25	9	34					50	34
10	44	46	41	45	27	10	35					50	35
11	45	47	43	47	28	11	36					51	36
12	47	49	45	50	29	12	37					52	37
13	48	50	47	52	30	13	38					53	38
14	50	51	49	54	31	14	39					54	39
15	51	52	51	56	32	15	40					54	40
16	53	54	53	59	33	16	41					55	41
17	55	55	55	61	34	17	42					56	42
18	56	56	57	63	36	18	43					56	43
19	58	58	59	66	37	19	44					57	44
20	60	59	61	68	38	20	45					58	45
21	62	61	63		38	21	46					59	46
22	64	63	65		39	22	47					59	47
23	66	64	67		40	23	48					60	48
24	68	66	69		41	24	49					61	49
							50					62	50

Table 28

**ASVAB Form 15f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>	<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>
0	20	26	21	20	20	22	0	45					61	49	45
1	20	26	22	20	20	22	1	46					61	49	46
2	22	27	23	20	20	23	2	47					61	50	47
3	24	28	24	23	20	23	3	48					62	51	48
4	26	30	25	26	21	24	4	49					62	51	49
5	28	31	26	29	22	24	5	50					62	52	50
6	30	33	28	32	23	25	6	51						52	51
7	32	34	29	35	24	25	7	52						53	52
8	34	35	30	38	25	26	8	53						54	53
9	36	37	31	41	26	26	9	54						54	54
10	38	38	32	44	27	27	10	55						55	55
11	40	40	33	47	28	28	11	56						55	56
12	42	41	34	51	29	28	12	57						56	57
13	44	42	36	54	30	29	13	58						57	58
14	46	44	37	57	31	29	14	59						57	59
15	47	45	38	60	32	30	15	60						58	60
16	49	47	39		33	31	16	61						58	61
17	51	48	40		34	31	17	62						59	62
18	53	49	41		35	32	18	63						60	63
19	55	51	42		36	33	19	64						60	64
20	57	52	44		37	33	20	65						61	65
21	59	54	45		38	34	21	66						61	66
22	61	55	46		39	34	22	67						62	67
23	63	56	47		40	35	23	68						63	68
24	65	58	48		41	36	24	69						63	69
25	67	59	49		42	36	25	70						64	70
26		61	50		43	37	26	71						64	71
27		62	52		44	38	27	72						65	72
28		63	53		46	38	28	73						65	73
29		65	54		47	39	29	74						66	74
30		66	55		48	40	30	75						67	75
31			56		49	40	31	76						67	76
32			57		50	41	32	77						68	77
33			58		51	41	33	78						68	78
34			60		52	42	34	79						69	79
35			61		53	43	35	80						69	80
36					54	43	36	81						70	81
37					55	44	37	82						70	82
38					56	44	38	83						71	83
39					57	45	39	84						71	84
40					58	46	40	85							85
41					58	46	41	86							86
42					59	47	42	87							87
43					60	47	43	88							88
44					60	48	44	89							89

(continued)

Table 28
(continued)

**ASVAB Form 15f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	25	29	24	23	20	0		25	69	68	70		39	25
1	27	30	26	23	20	1		26					40	26
2	29	31	27	26	20	2		27					41	27
3	31	33	29	28	21	3		28					42	28
4	32	34	31	31	21	4		29					43	29
5	34	36	32	33	22	5		30					44	30
6	36	38	34	36	23	6		31					45	31
7	38	39	36	38	24	7		32					45	32
8	39	41	37	41	25	8		33					46	33
9	41	42	39	43	26	9		34					47	34
10	43	44	41	46	27	10		35					48	35
11	45	46	43	48	27	11		36					49	36
12	46	47	44	51	28	12		37					50	37
13	48	49	46	53	29	13		38					50	38
14	50	50	48	56	30	14		39					51	39
15	52	52	50	59	31	15		40					52	40
16	53	53	52	61	32	16		41					53	41
17	55	55	54	64	33	17		42					54	42
18	57	57	56	66	33	18		43					55	43
19	59	58	58	69	34	19		44					56	44
20	61	60	60	70	35	20		45					56	45
21	62	61	62		36	21		46					57	46
22	64	63	65		37	22		47					58	47
23	66	65	67		38	23		48					59	48
24	68	66	69		39	24		49					60	49
								50					61	50

Table 29

**ASVAB Form 15g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	22	0	45					60	49	45
1	20	26	20	20	20	22	1	46					61	49	46
2	22	27	20	21	20	23	2	47					61	50	47
3	24	28	22	24	20	23	3	48					62	51	48
4	26	30	23	27	20	24	4	49					62	51	49
5	28	31	24	30	21	24	5	50					62	52	50
6	30	33	25	33	22	25	6	51						52	51
7	32	34	27	36	23	25	7	52						53	52
8	34	35	28	39	24	26	8	53						54	53
9	36	37	29	42	25	26	9	54						54	54
10	38	38	30	45	26	27	10	55						55	55
11	40	40	32	48	27	28	11	56						55	56
12	42	41	33	51	28	28	12	57						56	57
13	44	42	34	54	29	29	13	58						57	58
14	46	44	35	57	30	29	14	59						57	59
15	47	45	37	60	31	30	15	60						58	60
16	49	46	38		32	31	16	61						58	61
17	51	48	39		33	31	17	62						59	62
18	53	49	40		34	32	18	63						60	63
19	55	51	42		35	33	19	64						60	64
20	57	52	43		36	33	20	65						61	65
21	59	53	44		37	34	21	66						61	66
22	61	55	45		39	34	22	67						62	67
23	63	56	47		40	35	23	68						63	68
24	65	58	48		41	36	24	69						63	69
25	67	59	49		42	36	25	70						64	70
26		60	50		43	37	26	71						64	71
27		62	52		44	38	27	72						65	72
28		63	53		45	38	28	73						65	73
29		64	54		46	39	29	74						66	74
30		66	55		47	40	30	75						67	75
31			57		48	40	31	76						67	76
32			58		49	41	32	77						68	77
33			59		50	41	33	78						68	78
34			60		51	42	34	79						69	79
35			61		52	43	35	80						69	80
36					53	43	36	81						70	81
37					55	44	37	82						70	82
38					56	44	38	83						71	83
39					57	45	39	84						71	84
40					57	46	40	85							85
41					58	46	41	86							86
42					59	47	42	87							87
43					60	47	43	88							88
44					60	48	44	89							89

(continued)

Table 29
(continued)

**ASVAB Form 15g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	25	29	24	23	20	0		25	69	68	70		39	25
1	27	30	26	23	20	1		26					40	26
2	29	31	27	26	20	2		27					41	27
3	31	33	29	28	20	3		28					41	28
4	32	34	31	31	20	4		29					42	29
5	34	36	32	33	21	5		30					43	30
6	36	38	34	36	22	6		31					44	31
7	38	39	36	38	22	7		32					45	32
8	39	41	37	41	23	8		33					46	33
9	41	42	39	43	24	9		34					47	34
10	43	44	41	46	25	10		35					48	35
11	45	46	43	48	26	11		36					49	36
12	46	47	44	51	27	12		37					50	37
13	48	49	46	53	28	13		38					50	38
14	50	50	48	56	29	14		39					51	39
15	52	52	50	59	30	15		40					52	40
16	53	53	52	61	31	16		41					53	41
17	55	55	54	64	31	17		42					54	42
18	57	57	56	66	32	18		43					55	43
19	59	58	58	69	33	19		44					56	44
20	61	60	60	70	34	20		45					57	45
21	62	61	62		35	21		46					58	46
22	64	63	65		36	22		47					59	47
23	66	65	67		37	23		48					60	48
24	68	66	69		38	24		49					60	49
								50					61	50

Table 30

**ASVAB Form 16f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	21	0	45					60	49	45
1	22	26	20	20	20	21	1	46					60	49	46
2	24	26	20	22	20	22	2	47					60	50	47
3	26	27	21	25	20	23	3	48					61	51	48
4	28	29	22	28	20	23	4	49					61	51	49
5	29	30	23	31	20	24	5	50					61	52	50
6	31	32	25	34	20	24	6	51						52	51
7	33	33	26	36	20	25	7	52						53	52
8	35	35	27	39	21	25	8	53						54	53
9	37	36	28	42	22	26	9	54						54	54
10	39	38	30	45	23	27	10	55						55	55
11	41	39	31	48	24	27	11	56						56	56
12	42	40	32	51	25	28	12	57						56	57
13	44	42	33	53	26	28	13	58						57	58
14	46	43	35	56	27	29	14	59						57	59
15	48	45	36	59	28	30	15	60						58	60
16	50	46	37		30	30	16	61						59	61
17	52	48	39		31	31	17	62						59	62
18	54	49	40		32	32	18	63						60	63
19	55	51	41		33	32	19	64						60	64
20	57	52	42		34	33	20	65						61	65
21	59	54	44		35	34	21	66						62	66
22	61	55	45		37	34	22	67						62	67
23	63	56	46		38	35	23	68						63	68
24	65	58	47		39	36	24	69						64	69
25	67	59	49		40	36	25	70						64	70
26		61	50		41	37	26	71						65	71
27		62	51		42	37	27	72						65	72
28		64	53		43	38	28	73						66	73
29		65	54		45	39	29	74						66	74
30		66	55		46	39	30	75						67	75
31			56		47	40	31	76						68	76
32			58		48	41	32	77						68	77
33			59		49	41	33	78						69	78
34			60		50	42	34	79						69	79
35			61		51	43	35	80						70	80
36					52	43	36	81						70	81
37					53	44	37	82						71	82
38					54	44	38	83						71	83
39					55	45	39	84						72	84
40					56	46	40	85							85
41					57	46	41	86							86
42					58	47	42	87							87
43					59	48	43	88							88
44					59	48	44	89							89

(continued)

Table 30
(continued)

**ASVAB Form 16f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	29	29	24	23	20	0	11	25	68	67	70		38	25
1	31	30	25	25	20	1	11	26					39	26
2	32	32	27	27	20	2	11	27					40	27
3	34	33	28	29	20	3	11	28					41	28
4	35	35	30	32	20	4	11	29					42	29
5	37	37	32	34	20	5	11	30					43	30
6	38	38	33	36	21	6	11	31					44	31
7	40	40	35	39	22	7	11	32					45	32
8	41	41	37	41	23	8	11	33					46	33
9	43	43	39	43	24	9	11	34					47	34
10	45	44	40	45	25	10	11	35					48	35
11	46	46	42	48	26	11	11	36					48	36
12	48	47	44	50	27	12	11	37					49	37
13	49	49	46	52	28	13	11	38					50	38
14	51	50	48	55	28	14	11	39					51	39
15	52	52	50	57	29	15	11	40					52	40
16	54	54	52	59	30	16	11	41					53	41
17	55	55	54	61	31	17	11	42					54	42
18	57	57	56	64	32	18	11	43					55	43
19	58	58	58	66	33	19	11	44					56	44
20	60	60	60	68	34	20	11	45					57	45
21	62	61	62		35	21	11	46					57	46
22	63	63	64		36	22	11	47					58	47
23	65	64	67		37	23	11	48					59	48
24	66	66	69		38	24	11	49					60	49
							11	50					61	50

Table 31

**ASVAB Form 16g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw		Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	21	0		45					60	49	45
1	22	26	20	20	20	21	1		46					61	49	46
2	24	28	20	21	20	22	2		47					61	50	47
3	26	29	20	24	20	23	3		48					62	51	48
4	28	30	21	27	20	23	4		49					62	51	49
5	29	32	22	30	20	24	5		50					62	52	50
6	31	33	23	33	21	24	6		51						52	51
7	33	35	25	36	22	25	7		52						53	52
8	35	36	26	39	23	25	8		53						54	53
9	37	37	27	42	24	26	9		54						54	54
10	39	39	29	45	25	27	10		55						55	55
11	41	40	30	48	26	27	11		56						56	56
12	42	41	31	51	27	28	12		57						56	57
13	44	43	33	54	27	28	13		58						57	58
14	46	44	34	57	29	29	14		59						57	59
15	48	45	35	60	30	30	15		60						58	60
16	50	47	36		31	30	16		61						59	61
17	52	48	38		32	31	17		62						59	62
18	54	49	39		33	32	18		63						60	63
19	55	51	40		34	32	19		64						60	64
20	57	52	42		35	33	20		65						61	65
21	59	54	43		37	34	21		66						62	66
22	61	55	44		38	34	22		67						62	67
23	63	56	46		39	35	23		68						63	68
24	65	58	47		40	36	24		69						64	69
25	67	59	48		41	36	25		70						64	70
26		60	50		42	37	26		71						65	71
27		62	51		43	37	27		72						65	72
28		63	52		44	38	28		73						66	73
29		64	54		46	39	29		74						66	74
30		66	55		47	39	30		75						67	75
31			56		48	40	31		76						68	76
32			58		49	41	32		77						68	77
33			59		50	41	33		78						69	78
34			60		51	42	34		79						69	79
35			61		52	43	35		80						70	80
36					53	43	36		81						70	81
37					54	44	37		82						71	82
38					55	44	38		83						71	83
39					56	45	39		84						72	84
40					57	46	40		85							85
41					58	46	41		86							86
42					59	47	42		87							87
43					59	48	43		88							88
44					60	48	44		89							89

(continued)

Table 31
(continued)

**ASVAB Form 16g Conversion of Raw Test Score
to 1980 Standard Score Equivalents**

Raw	AS	MK	MC	EI	VE	Raw	Raw	AS	MK	MC	EI	VE	Raw
0	29	29	24	23	20	0	25	68	67	70		38	25
1	31	30	25	25	20	1	26					39	26
2	32	32	27	27	20	2	27					40	27
3	34	33	28	29	20	3	28					41	28
4	35	35	30	32	20	4	29					42	29
5	37	37	32	34	20	5	30					43	30
6	38	38	33	36	20	6	31					44	31
7	40	40	35	39	21	7	32					44	32
8	41	41	37	41	22	8	33					45	33
9	43	43	39	43	23	9	34					46	34
10	45	44	40	45	24	10	35					47	35
11	46	46	42	48	25	11	36					48	36
12	48	47	44	50	26	12	37					49	37
13	49	49	46	52	26	13	38					50	38
14	51	50	48	55	27	14	39					51	39
15	52	52	50	57	28	15	40					52	40
16	54	54	52	59	29	16	41					53	41
17	55	55	54	61	30	17	42					54	42
18	57	57	56	64	31	18	43					55	43
19	58	58	58	66	32	19	44					56	44
20	60	60	60	68	33	20	45					57	45
21	62	61	62		34	21	46					58	46
22	63	63	64		35	22	47					59	47
23	65	64	67		36	23	48					60	48
24	66	66	69		37	24	49					61	49
							50					62	50

Table 32

**ASVAB Form 17f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	21	0	45					60	48	45
1	21	27	21	20	20	21	1	46					61	49	46
2	23	28	22	22	20	22	2	47					61	50	47
3	25	30	23	25	20	22	3	48					61	50	48
4	27	31	24	28	20	23	4	49					62	51	49
5	28	32	25	31	20	23	5	50					62	52	50
6	30	34	27	34	21	24	6	51						52	51
7	32	35	28	37	22	25	7	52						53	52
8	34	36	29	40	23	25	8	53						53	53
9	36	38	30	42	24	26	9	54						54	54
10	38	39	31	45	25	26	10	55						55	55
11	40	40	33	48	26	27	11	56						55	56
12	42	42	34	51	27	27	12	57						56	57
13	44	43	35	54	28	28	13	58						56	58
14	46	44	36	57	29	29	14	59						57	59
15	48	46	37	60	30	29	15	60						58	60
16	50	47	38		31	30	16	61						58	61
17	52	48	40		32	31	17	62						59	62
18	54	50	41		33	31	18	63						60	63
19	56	51	42		34	32	19	64						60	64
20	58	52	43		35	33	20	65						61	65
21	60	53	44		37	33	21	66						61	66
22	62	55	45		38	34	22	67						62	67
23	64	56	47		39	35	23	68						63	68
24	65	57	48		40	35	24	69						63	69
25	67	59	49		41	36	25	70						64	70
26		60	50		42	37	26	71						64	71
27		61	51		43	37	27	72						65	72
28		63	53		44	38	28	73						66	73
29		64	54		45	38	29	74						66	74
30		65	55		47	39	30	75						67	75
31			56		48	40	31	76						67	76
32			57		49	40	32	77						68	77
33			58		50	41	33	78						68	78
34			60		51	42	34	79						69	79
35			61		52	42	35	80						69	80
36					53	43	36	81						70	81
37					54	43	37	82						70	82
38					55	44	38	83						71	83
39					56	45	39	84						71	84
40					57	45	40	85							85
41					58	46	41	86							86
42					59	47	42	87							87
43					59	47	43	88							88
44					60	48	44	89							89

(continued)

Table 32
(continued)

**ASVAB Form 17f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	26	29	25	23	20	0	25	68	68	70			39	25
1	28	29	26	26	20	1	26						40	26
2	29	30	27	28	20	2	27						41	27
3	31	32	29	30	20	3	28						42	28
4	33	34	30	32	21	4	29						43	29
5	34	35	31	35	22	5	30						44	30
6	36	37	33	37	23	6	31						44	31
7	38	39	35	39	24	7	32						45	32
8	39	40	36	41	25	8	33						46	33
9	41	42	38	44	25	9	34						47	34
10	43	44	40	46	26	10	35						48	35
11	45	45	42	48	27	11	36						49	36
12	46	47	44	50	28	12	37						50	37
13	48	49	46	53	29	13	38						50	38
14	50	50	48	55	30	14	39						51	39
15	51	52	50	57	31	15	40						52	40
16	53	54	52	60	31	16	41						53	41
17	55	55	54	62	32	17	42						54	42
18	56	57	56	64	33	18	43						55	43
19	58	58	58	66	34	19	44						56	44
20	60	60	60	69	35	20	45						57	45
21	61	62	63		36	21	46						57	46
22	63	63	65		37	22	47						58	47
23	65	65	67		37	23	48						59	48
24	66	67	69		38	24	49						60	49
							50						61	50

Table 33

**ASVAB Form 17g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>	<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>
0	20	26	20	20	20	21	0	45					60	48	45
1	21	26	20	20	20	21	1	46					61	49	46
2	23	28	20	20	20	22	2	47					61	50	47
3	25	29	22	23	20	22	3	48					61	50	48
4	27	31	23	26	20	23	4	49					62	51	49
5	28	32	24	30	20	23	5	50					62	52	50
6	30	33	25	33	21	24	6	51						52	51
7	32	35	27	36	22	25	7	52						53	52
8	34	36	28	39	23	25	8	53						53	53
9	36	37	29	42	24	26	9	54						54	54
10	38	39	30	45	25	26	10	55						55	55
11	40	40	32	48	26	27	11	56						55	56
12	42	42	33	51	27	27	12	57						56	57
13	44	43	34	54	28	28	13	58						56	58
14	46	44	35	58	29	29	14	59						57	59
15	48	46	36	61	30	29	15	60						58	60
16	50	47	38		31	30	16	61						58	61
17	52	48	39		32	31	17	62						59	62
18	54	50	40		33	31	18	63						60	63
19	56	51	41		34	32	19	64						60	64
20	58	53	43		36	33	20	65						61	65
21	60	54	44		37	33	21	66						61	66
22	62	55	45		38	34	22	67						62	67
23	64	57	46		39	35	23	68						63	68
24	65	58	47		40	35	24	69						63	69
25	67	59	49		41	36	25	70						64	70
26		61	50		42	37	26	71						64	71
27		62	51		43	37	27	72						65	72
28		63	52		44	38	28	73						66	73
29		65	54		46	38	29	74						66	74
30		66	55		47	39	30	75						67	75
31			56		48	40	31	76						67	76
32			57		49	40	32	77						68	77
33			58		50	41	33	78						68	78
34			60		51	42	34	79						69	79
35			61		52	42	35	80						69	80
36					53	43	36	81						70	81
37					54	43	37	82						70	82
38					55	44	38	83						71	83
39					56	45	39	84						71	84
40					57	45	40	85							85
41					58	46	41	86							86
42					59	47	42	87							87
43					59	47	43	88							88
44					60	48	44	89							89

(continued)

Table 33
(continued)

**ASVAB Form 17g Conversion of Raw Test Scores
1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	26	29	25	23	20	0		25	68	68	70		38	25
1	28	29	26	26	20	1		26					39	26
2	29	30	27	28	20	2		27					40	27
3	31	32	29	30	20	3		28					41	28
4	33	34	30	32	20	4		29					42	29
5	34	35	31	35	20	5		30					43	30
6	36	37	33	37	21	6		31					44	31
7	38	39	35	39	22	7		32					45	32
8	39	40	36	41	23	8		33					46	33
9	41	42	38	44	24	9		34					47	34
10	43	44	40	46	25	10		35					48	35
11	45	45	42	48	26	11		36					49	36
12	46	47	44	50	27	12		37					49	37
13	48	49	46	53	28	13		38					50	38
14	50	50	48	55	28	14		39					51	39
15	51	52	50	57	29	15		40					52	40
16	53	54	52	60	30	16		41					53	41
17	55	55	54	62	31	17		42					54	42
18	56	57	56	64	32	18		43					55	43
19	58	58	58	66	33	19		44					56	44
20	60	60	60	69	34	20		45					57	45
21	61	62	63		35	21		46					58	46
22	63	63	65		36	22		47					59	47
23	65	65	67		37	23		48					59	48
24	66	67	69		38	24		49					60	49
								50					61	50

Table 34

**ASVAB Form 18f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	27	20	20	20	22	0	45					61	49	45
1	20	28	20	22	20	22	1	46					61	50	46
2	22	29	20	26	20	23	2	47					62	50	47
3	24	30	20	29	20	23	3	48					62	51	48
4	26	31	22	32	21	24	4	49					62	52	49
5	28	32	23	35	22	24	5	50					62	52	50
6	30	33	24	38	23	25	6	51						53	51
7	32	34	26	41	24	26	7	52						53	52
8	34	35	27	44	25	26	8	53						54	53
9	37	37	29	46	26	27	9	54						55	54
10	39	38	30	48	27	27	10	55						55	55
11	41	39	32	50	28	28	11	56						56	56
12	42	40	33	52	29	29	12	57						56	57
13	44	41	35	55	30	30	13	58						57	58
14	46	43	36	57	31	31	14	59						58	59
15	48	44	37	60	32	31	15	60						58	60
16	50	45	38		33	32	16	61						59	61
17	52	47	39		35	33	17	62						59	62
18	53	48	40		36	33	18	63						60	63
19	55	50	42		37	34	19	64						61	64
20	57	51	43		38	35	20	65						61	65
21	59	53	44		39	35	21	66						62	66
22	61	54	45		41	36	22	67						63	67
23	63	56	46		42	36	23	68						63	68
24	66	57	47		43	37	24	69						64	69
25	68	59	49		44	38	25	70						64	70
26		60	50		45	38	26	71						65	71
27		62	51		46	39	27	72						65	72
28		63	52		47	39	28	73						66	73
29		65	53		48	40	29	74						66	74
30		66	55		49	40	30	75						67	75
31			56		50	41	31	76						67	76
32			57		51	42	32	77						68	77
33			58		52	42	33	78						68	78
34			59		54	43	34	79						69	79
35			61		55	43	35	80						70	80
36					56	44	36	81						70	81
37					57	45	37	82						71	82
38					58	45	38	83						72	83
39					59	46	39	84						72	84
40					60	46	40								
41					60	47	41								
42					61	48	42								
43					61	48	43								
44					61	49	44								

(continued)

Table 34
(continued)

**ASVAB Form 18f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	AS	MK	MC	EI	VE	Raw		Raw	AS	MK	MC	EI	VE	Raw
0	25	29	23	22	20	0		25	69	68	70		40	25
1	27	32	25	24	20	1		26					41	26
2	29	33	27	27	20	2		27					42	27
3	31	35	29	29	20	3		28					43	28
4	32	36	31	31	21	4		29					44	29
5	34	38	33	33	21	5		30					44	30
6	36	39	34	35	22	6		31					45	31
7	38	41	36	38	23	7		32					46	32
8	40	42	37	41	23	8		33					47	33
9	41	44	39	44	24	9		34					48	34
10	43	45	41	46	25	10		35					49	35
11	45	47	42	49	26	11		36					49	36
12	46	48	44	52	27	12		37					50	37
13	48	50	46	54	29	13		38					51	38
14	50	51	48	56	30	14		39					52	39
15	52	52	50	59	31	15		40					53	40
16	53	54	53	61	32	16		41					53	41
17	55	55	55	63	33	17		42					54	42
18	57	57	57	65	34	18		43					55	43
19	58	58	59	67	35	19		44					56	44
20	60	60	61	69	36	20		45					57	45
21	62	61	63		37	21		46					57	46
22	64	63	65		38	22		47					58	47
23	65	64	67		39	23		48					59	48
24	67	66	69		39	24		49					60	49
								50					61	50

Table 35

**ASVAB Form 18g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	27	20	20	20	22	0	45					61	49	45
1	20	28	20	21	20	22	1	46					61	50	46
2	22	29	21	25	20	23	2	47					62	50	47
3	24	30	22	28	20	23	3	48					62	51	48
4	26	31	22	30	21	24	4	49					62	52	49
5	28	32	23	33	22	24	5	50					62	52	50
6	30	34	24	36	23	25	6	51						53	51
7	32	35	25	39	24	26	7	52						53	52
8	34	36	27	42	25	26	8	53						54	53
9	37	37	28	45	26	27	9	54						55	54
10	39	38	29	47	27	27	10	55						55	55
11	41	39	31	50	28	28	11	56						56	56
12	42	40	32	52	29	29	12	57						56	57
13	44	41	33	55	30	30	13	58						57	58
14	46	43	35	57	31	31	14	59						58	59
15	48	44	36	60	32	31	15	60						58	60
16	50	45	37		33	32	16	61						59	61
17	52	47	38		35	33	17	62						59	62
18	53	48	39		36	33	18	63						60	63
19	55	50	41		37	34	19	64						61	64
20	57	52	42		38	35	20	65						61	65
21	59	53	43		39	35	21	66						62	66
22	61	55	44		41	36	22	67						63	67
23	63	57	45		42	36	23	68						63	68
24	66	58	47		43	37	24	69						64	69
25	68	60	48		44	38	25	70						64	70
26		61	49		45	38	26	71						65	71
27		62	51		46	39	27	72						65	72
28		64	52		47	39	28	73						66	73
29		65	53		48	40	29	74						66	74
30		66	55		49	40	30	75						67	75
31			56		50	41	31	76						67	76
32			57		51	42	32	77						68	77
33			59		52	42	33	78						68	78
34			60		54	43	34	79						69	79
35			61		55	43	35	80						70	80
36					56	44	36	81						70	81
37					57	45	37	82						71	82
38					58	45	38	83						72	83
39					59	46	39	84						72	84
40					60	46	40								
41					60	47	41								
42					61	48	42								
43					61	48	43								
44					61	49	44								

(continued)

Table 35
(continued)

**ASVAB Form 18g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u>Raw</u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	24	29	23	22	20	0	25	69	68	70			39	25
1	26	30	25	24	20	1	26						40	26
2	28	32	27	27	20	2	27						41	27
3	30	33	29	29	21	3	28						42	28
4	32	35	31	31	21	4	29						43	29
5	34	36	33	33	22	5	30						43	30
6	35	38	34	35	22	6	31						44	31
7	37	40	36	38	23	7	32						45	32
8	39	41	37	41	23	8	33						45	33
9	41	43	39	44	24	9	34						47	34
10	42	44	41	46	25	10	35						48	35
11	44	46	42	49	26	11	36						49	36
12	46	47	44	52	27	12	37						50	37
13	48	49	46	54	28	13	38						51	38
14	49	50	48	56	29	14	39						52	39
15	51	52	50	59	30	15	40						52	40
16	53	53	53	61	31	16	41						53	41
17	55	55	55	63	32	17	42						54	42
18	56	56	57	65	33	18	43						55	43
19	58	58	59	67	34	19	44						56	44
20	60	59	61	69	35	20	45						57	45
21	62	61	63		35	21	46						58	46
22	64	62	65		36	22	47						59	47
23	65	64	67		37	23	48						59	48
24	67	66	69		38	24	49						60	49
							50						61	50

Table 36

**ASVAB Form 19f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>	<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>
0	20	27	20	20	20	22	0	45					61	49	45
1	20	28	20	22	20	22	1	46					61	50	46
2	22	29	20	26	20	23	2	47					62	50	47
3	23	30	20	30	20	23	3	48					62	51	48
4	25	31	22	34	20	24	4	49					63	51	49
5	27	32	23	37	22	24	5	50					63	52	50
6	29	33	24	40	23	25	6	51						53	51
7	31	34	26	43	24	25	7	52						53	52
8	33	35	27	45	25	26	8	53						54	53
9	35	37	29	47	26	26	9	54						54	54
10	37	38	30	50	27	27	10	55						55	55
11	39	39	32	52	28	27	11	56						56	56
12	41	40	33	54	29	28	12	57						56	57
13	43	41	35	56	30	29	13	58						57	58
14	46	43	36	58	32	29	14	59						57	59
15	48	44	37	61	33	30	15	60						58	60
16	50	45	38		34	31	16	61						58	61
17	52	47	39		35	31	17	62						59	62
18	54	48	40		36	32	18	63						60	63
19	57	50	42		38	33	19	64						60	64
20	59	51	43		39	34	20	65						61	65
21	61	53	44		40	34	21	66						61	66
22	63	54	45		41	35	22	67						62	67
23	65	56	46		42	36	23	68						62	68
24	67	57	47		43	36	24	69						63	69
25	69	59	49		44	37	25	70						63	70
26		60	50		45	37	26	71						64	71
27		62	51		46	38	27	72						64	72
28		63	52		47	39	28	73						65	73
29		65	53		48	39	29	74						65	74
30		66	55		49	40	30	75						66	75
31			56		50	41	31	76						66	76
32			57		51	41	32	77						67	77
33			58		52	42	33	78						67	78
34			59		53	43	34	79						68	79
35			61		55	43	35	80						68	80
36					56	44	36	81						69	81
37					57	44	37	82						69	82
38					58	45	38	83						71	83
39					59	46	39	84						71	84
40					59	46	40								
41					60	47	41								
42					60	47	42								
43					61	48	43								
44					61	49	44								

(continued)

Table 36
(continued)

**ASVAB Form 19f Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	AS	MK	MC	EI	VE	Raw	Raw	AS	MK	MC	EI	VE	Raw
0	24	29	24	22	20	0	25	69	68	70		41	25
1	26	32	26	25	20	1	26					41	26
2	27	33	28	27	20	2	27					42	27
3	29	35	30	29	20	3	28					43	28
4	31	36	32	32	20	4	29					44	29
5	32	38	33	34	21	5	30					45	30
6	34	39	35	36	22	6	31					46	31
7	36	41	37	39	23	7	32					46	32
8	38	42	39	42	23	8	33					47	33
9	40	44	40	44	24	9	34					48	34
10	42	45	42	47	25	10	35					49	35
11	44	47	44	50	26	11	36					50	36
12	46	48	46	52	27	12	37					51	37
13	47	50	48	54	29	13	38					51	38
14	49	51	50	57	30	14	39					52	39
15	51	52	52	59	31	15	40					53	40
16	53	54	54	61	32	16	41					54	41
17	54	55	56	63	34	17	42					55	42
18	56	57	58	64	35	18	43					55	43
19	58	58	60	66	36	19	44					56	44
20	59	60	62	69	36	20	45					57	45
21	61	61	64		37	21	46					58	46
22	63	63	65		38	22	47					58	47
23	65	64	67		39	23	48					59	48
24	67	66	69		40	24	49					60	49
							50					61	50

Table 37

**ASVAB Form 19g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>	<u>GS</u>	<u>AR</u>	<u>WK</u>	<u>PC</u>	<u>NO</u>	<u>CS</u>	<u>Raw</u>
0	20	27	20	20	20	22	0	11	45			61	49	45
1	20	28	20	22	20	22	1	11	46			61	50	46
2	22	29	21	25	20	23	2	11	47			62	50	47
3	23	30	22	28	20	24	3	11	48			62	51	48
4	25	31	22	31	20	24	4	11	49			63	52	49
5	27	32	23	34	22	25	5	11	50			63	52	50
6	29	34	24	37	23	26	6	11	51				53	51
7	31	35	25	40	24	26	7	11	52				53	52
8	33	36	27	43	25	27	8	11	53				54	53
9	35	37	28	46	26	28	9	11	54				55	54
10	37	38	29	48	27	29	10	11	55				55	55
11	39	39	31	50	28	30	11	11	56				56	56
12	41	40	32	53	29	31	12	11	57				56	57
13	43	41	33	55	30	31	13	11	58				57	58
14	46	43	35	58	32	32	14	11	59				57	59
15	48	44	36	60	33	33	15	11	60				58	60
16	50	45	37		34	34	16	11	61				59	61
17	52	47	38		35	35	17	11	62				59	62
18	54	48	39		36	35	18	11	63				60	63
19	57	50	41		38	36	19	11	64				60	64
20	59	52	42		39	37	20	11	65				61	65
21	61	53	43		40	37	21	11	66				61	66
22	63	55	44		41	38	22	11	67				62	67
23	65	57	45		42	38	23	11	68				62	68
24	67	58	47		43	38	24	11	69				63	69
25	69	60	48		44	39	25	11	70				63	70
26		61	49		45	39	26	11	71				64	71
27		62	51		46	40	27	11	72				65	72
28		64	52		47	40	28	11	73				65	73
29		65	53		48	41	29	11	74				66	74
30		66	55		49	41	30	11	75				66	75
31			56		50	42	31	11	76				67	76
32			57		51	42	32	11	77				67	77
33			59		52	43	33	11	78				68	78
34			60		53	43	34	11	79				68	79
35			61		55	44	35	11	80				69	80
36					56	44	36	11	81				69	81
37					57	45	37	11	82				70	82
38					58	45	38	11	83				72	83
39					59	46	39	11	84				72	84
40					59	46	40	11						
41					60	47	41	11						
42					60	48	42	11						
43					61	48	43	11						
44					61	49	44	11						

(continued)

Table 37
(continued)

**ASVAB Form 19g Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u> </u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	24	29	24	22	20	0		25	69	68	70		39	25
1	26	30	26	25	20	1		26					40	26
2	27	32	28	27	20	2		27					41	27
3	29	33	30	29	21	3		28					42	28
4	31	35	32	32	21	4		29					43	29
5	32	36	33	34	22	5		30					43	30
6	34	38	35	36	22	6		31					44	31
7	36	40	37	39	23	7		32					45	32
8	38	41	39	42	23	8		33					46	33
9	40	43	40	44	24	9		34					47	34
10	42	44	42	47	25	10		35					48	35
11	44	46	44	50	26	11		36					49	36
12	46	47	46	52	27	12		37					50	37
13	47	49	48	54	28	13		38					51	38
14	49	50	50	57	29	14		39					52	39
15	51	52	52	59	30	15		40					52	40
16	53	53	54	61	31	16		41					53	41
17	54	55	56	63	32	17		42					54	42
18	56	56	58	64	33	18		43					55	43
19	58	58	60	66	34	19		44					56	44
20	59	59	62	69	35	20		45					57	45
21	61	61	64		35	21		46					58	46
22	63	62	65		36	22		47					59	47
23	65	64	67		37	23		48					59	48
24	67	66	69		38	24		49					60	49
								50					61	50

Table 38

**ASVAB Form 20a Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	25	20	20	20	22	0	45					61	50	45
1	20	27	20	20	20	22	1	46					61	51	46
2	22	28	20	23	20	23	2	47					61	52	47
3	24	29	20	26	20	23	3	48					62	52	48
4	26	30	21	30	20	24	4	49					62	53	49
5	28	31	23	33	20	25	5	50					62	54	50
6	30	32	24	36	21	25	6	51						54	51
7	32	34	25	39	22	26	7	52						55	52
8	34	35	26	42	23	26	8	53						56	53
9	36	36	28	44	24	27	9	54						56	54
10	38	38	29	47	25	28	10	55						57	55
11	40	39	30	50	26	28	11	56						57	56
12	42	40	32	52	27	29	12	57						58	57
13	44	41	33	55	28	29	13	58						59	58
14	46	43	35	58	29	30	14	59						59	59
15	47	44	36	61	30	31	15	60						60	60
16	49	46	37		31	32	16	61						61	61
17	51	47	39		32	32	17	62						61	62
18	53	48	40		34	33	18	63						62	63
19	55	50	41		35	34	19	64						63	64
20	57	51	42		36	34	20	65						63	65
21	59	53	43		37	35	21	66						64	66
22	61	54	45		38	36	22	67						64	67
23	63	56	46		40	36	23	68						65	68
24	65	58	47		41	37	24	69						65	69
25	67	59	48		42	38	25	70						66	70
26		61	50		43	38	26	71						67	71
27		62	51		44	39	27	72						67	72
28		64	52		45	40	28	73						68	73
29		65	54		46	40	29	74						68	74
30		66	55		47	41	30	75						68	75
31			56		48	42	31	76						69	76
32			58		49	42	32	77						69	77
33			59		50	43	33	78						70	78
34			60		52	43	34	79						70	79
35			61		53	44	35	80						70	80
36					54	45	36	81						71	81
37					55	45	37	82						71	82
38					56	46	38	83						71	83
39					57	47	39	84						72	84
40					58	47	40	85							85
41					59	48	41	86							86
42					60	49	42	87							87
43					60	49	43	88							88
44					60	50	44	89							89

(continued)

Table 38
(continued)

**ASVAB Form 20a Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u> </u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MK</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	24	29	24	23	20	0		25	69	68	70		39	25
1	26	30	26	25	20	1		26					40	26
2	28	32	28	28	20	2		27					41	27
3	29	34	30	30	20	3		28					42	28
4	31	35	32	32	20	4		29					43	29
5	33	37	34	35	20	5		30					44	30
6	35	38	35	37	20	6		31					45	31
7	36	40	37	39	21	7		32					45	32
8	38	42	38	42	22	8		33					46	33
9	40	43	40	44	23	9		34					47	34
10	42	45	42	46	24	10		35					48	35
11	43	47	44	49	25	11		36					49	36
12	45	48	45	51	25	12		37					50	37
13	47	50	47	53	26	13		38					51	38
14	49	51	49	55	27	14		39					51	39
15	51	53	51	58	28	15		40					52	40
16	53	54	53	60	29	16		41					53	41
17	55	56	55	62	30	17		42					54	42
18	57	57	57	64	31	18		43					55	43
19	59	58	59	66	32	19		44					56	44
20	61	60	61	69	33	20		45					57	45
21	63	61	63		34	21		46					58	46
22	64	63	65		36	22		47					59	47
23	66	64	66		37	23		48					60	48
24	68	66	68		38	24		49					61	49
								50					62	50

Table 39

**ASVAB Form 20b Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	22	0	45					61	50	45
1	20	28	20	21	20	22	1	46					61	51	46
2	22	29	20	24	20	23	2	47					61	52	47
3	24	31	21	27	20	23	3	48					62	52	48
4	26	32	22	29	20	24	4	49					62	53	49
5	28	34	23	32	20	25	5	50					62	54	50
6	30	35	25	35	21	25	6	51						54	51
7	32	36	26	38	22	26	7	52						55	52
8	34	38	28	41	23	26	8	53						56	53
9	36	39	29	44	24	27	9	54						56	54
10	38	40	31	48	25	28	10	55						57	55
11	40	41	32	51	26	28	11	56						57	56
12	42	43	34	54	27	29	12	57						58	57
13	44	44	35	56	28	29	13	58						59	58
14	46	45	36	59	29	30	14	59						59	59
15	47	47	37	62	30	31	15	60						60	60
16	49	48	38		31	32	16	61						61	61
17	51	49	40		32	32	17	62						61	62
18	53	50	41		34	33	18	63						62	63
19	55	52	42		35	34	19	64						63	64
20	57	53	43		36	34	20	65						63	65
21	59	54	44		37	35	21	66						64	66
22	61	56	45		38	36	22	67						64	67
23	63	57	46		40	36	23	68						65	68
24	65	58	48		41	37	24	69						65	69
25	67	60	49		42	38	25	70						66	70
26		61	50		43	38	26	71						67	71
27		62	51		44	39	27	72						67	72
28		64	52		45	40	28	73						68	73
29		65	53		46	40	29	74						68	74
30		66	54		47	41	30	75						68	75
31			56		48	42	31	76						69	76
32			57		49	42	32	77						69	77
33			58		50	43	33	78						70	78
34			60		52	43	34	79						70	79
35			61		53	44	35	80						70	80
36					54	45	36	81						71	81
37					55	45	37	82						71	82
38					56	46	38	83						71	83
39					57	47	39	84						72	84
40					58	47	40	85							85
41					59	48	41	86							86
42					60	49	42	87							87
43					60	49	43	88							88
44					60	50	44	89							89

(continued)

Table 39
(continued)

**ASVAB Form 20b Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	AS	MK	MC	EI	VE	Raw		Raw	AS	MK	MC	EI	VE	Raw
0	24	29	24	23	20	0		25	69	68	70		39	25
1	26	31	26	25	20	1		26					40	26
2	28	32	28	28	20	2		27					41	27
3	29	34	30	30	20	3		28					42	28
4	31	36	32	32	20	4		29					43	29
5	33	37	34	35	20	5		30					44	30
6	35	38	35	37	21	6		31					45	31
7	36	40	37	39	22	7		32					46	32
8	38	41	38	42	23	8		33					47	33
9	40	43	40	44	24	9		34					47	34
10	42	44	42	46	25	10		35					48	35
11	43	46	44	49	26	11		36					49	36
12	45	48	45	51	27	12		37					50	37
13	47	49	47	53	28	13		38					51	38
14	49	51	49	55	29	14		39					52	39
15	51	52	51	58	30	15		40					53	40
16	53	54	53	60	31	16		41					54	41
17	55	56	55	62	32	17		42					54	42
18	57	57	57	64	33	18		43					55	43
19	59	59	59	66	34	19		44					56	44
20	61	60	61	69	35	20		45					57	45
21	63	61	63		35	21		46					58	46
22	64	63	65		36	22		47					59	47
23	66	64	66		37	23		48					60	48
24	68	66	68		38	24		49					61	49
								50					62	50

Table 40

**ASVAB Form 21a Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	22	0	45					61	50	45
1	20	27	20	20	20	22	1	46					61	50	46
2	22	29	20	22	20	23	2	47					61	51	47
3	24	30	20	24	20	23	3	48					61	52	48
4	26	32	22	26	20	24	4	49					62	52	49
5	28	33	23	29	21	25	5	50					62	53	50
6	30	34	25	31	22	25	6	51						53	51
7	32	36	26	34	23	26	7	52						54	52
8	34	37	27	37	24	26	8	53						55	53
9	36	38	29	41	25	27	9	54						55	54
10	38	39	30	44	26	27	10	55						56	55
11	39	40	32	48	27	28	11	56						57	56
12	41	42	33	52	28	29	12	57						57	57
13	43	43	35	55	29	29	13	58						58	58
14	45	44	36	58	30	30	14	59						58	59
15	47	45	37	61	31	31	15	60						59	60
16	49	46	38		32	31	16	61						60	61
17	50	47	40		34	32	17	62						60	62
18	52	49	41		35	33	18	63						61	63
19	54	50	42		36	34	19	64						62	64
20	56	51	43		37	34	20	65						62	65
21	59	53	44		38	35	21	66						63	66
22	61	54	45		39	35	22	67						63	67
23	63	55	46		40	36	23	68						64	68
24	65	57	47		41	37	24	69						65	69
25	68	58	48		42	37	25	70						65	70
26		60	49		43	38	26	71						66	71
27		61	51		44	39	27	72						66	72
28		63	52		45	39	28	73						67	73
29		65	53		46	40	29	74						68	74
30		66	54		47	40	30	75						68	75
31			56		48	41	31	76						69	76
32			57		49	42	32	77						69	77
33			58		51	42	33	78						69	78
34			60		52	43	34	79						70	79
35			61		53	44	35	80						70	80
36					54	44	36	81						71	81
37					55	45	37	82						71	82
38					56	45	38	83						71	83
39					57	46	39	84						72	84
40					58	47	40	85							85
41					59	47	41	86							86
42					59	48	42	87							87
43					60	48	43	88							88
44					60	49	44	89							89

(continued)

Table 40
(continued)

**ASVAB Form 21a Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	AS	MK	MC	EI	VE	Raw		Raw	AS	MK	MC	EI	VE	Raw
0	24	29	23	23	20	0		25	69	67	70		38	25
1	26	31	25	25	20	1		26					39	26
2	27	32	27	27	20	2		27					40	27
3	29	34	29	30	20	3		28					41	28
4	31	36	30	32	20	4		29					42	29
5	33	37	32	34	20	5		30					43	30
6	34	38	34	37	20	6		31					44	31
7	36	40	35	39	21	7		32					45	32
8	38	41	37	42	22	8		33					46	33
9	40	43	38	44	23	9		34					46	34
10	42	44	40	47	24	10		35					47	35
11	43	46	42	49	25	11		36					48	36
12	45	47	43	51	26	12		37					49	37
13	47	49	45	53	27	13		38					50	38
14	49	50	47	56	28	14		39					51	39
15	51	51	49	58	29	15		40					52	40
16	53	53	51	60	30	16		41					53	41
17	54	54	53	62	31	17		42					53	42
18	56	56	55	64	32	18		43					54	43
19	58	57	57	66	32	19		44					55	44
20	60	59	59	69	33	20		45					57	45
21	61	60	61		34	21		46					58	46
22	63	62	63		35	22		47					59	47
23	65	64	65		36	23		48					60	48
24	67	65	67		37	24		49					61	49
								50					62	50

Table 41

**ASVAB Form 21b Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw		Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	25	20	20	20	22	0		45					61	50	45
1	20	27	20	20	20	22	1		46					61	50	46
2	22	28	20	23	20	23	2		47					61	51	47
3	24	29	20	26	20	23	3		48					61	52	48
4	26	30	21	29	20	24	4		49					62	52	49
5	28	32	22	31	21	25	5		50					62	53	50
6	30	33	23	35	22	25	6		51						53	51
7	32	34	24	38	23	26	7		52						54	52
8	34	35	25	41	24	26	8		53						55	53
9	36	37	26	44	25	27	9		54						55	54
10	38	38	28	47	26	27	10		55						56	55
11	39	40	29	50	27	28	11		56						57	56
12	41	41	30	53	28	29	12		57						57	57
13	43	42	32	56	29	29	13		58						58	58
14	45	44	34	58	30	30	14		59						58	59
15	47	45	35	61	31	31	15		60						59	60
16	49	47	37		32	31	16		61						60	61
17	50	48	39		34	32	17		62						60	62
18	52	50	40		35	33	18		63						61	63
19	54	51	41		36	34	19		64						62	64
20	56	53	43		37	34	20		65						62	65
21	59	54	44		38	35	21		66						63	66
22	61	56	45		39	35	22		67						63	67
23	63	57	46		40	36	23		68						64	68
24	65	58	48		41	37	24		69						65	69
25	68	60	49		42	37	25		70						65	70
26		61	50		43	38	26		71						66	71
27		62	51		44	39	27		72						66	72
28		63	52		45	39	28		73						67	73
29		65	54		46	40	29		74						68	74
30		66	55		47	40	30		75						68	75
31			56		48	41	31		76						69	76
32			57		49	42	32		77						69	77
33			59		51	42	33		78						69	78
34			60		52	43	34		79						70	79
35			61		53	44	35		80						70	80
36					54	44	36		81						71	81
37					55	45	37		82						71	82
38					56	45	38		83						71	83
39					57	46	39		84						72	84
40					58	47	40		85							85
41					59	47	41		86							86
42					59	48	42		87							87
43					60	48	43		88							88
44					60	49	44		89							89

(continued)

Table 41
(continued)

**ASVAB Form 21b Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u> </u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	24	29	23	23	20	0		25	69	68	70		39	25
1	26	31	25	25	20	1		26					40	26
2	27	32	27	27	20	2		27					41	27
3	29	34	29	30	20	3		28					42	28
4	31	36	30	32	20	4		29					43	29
5	33	37	32	34	20	5		30					44	30
6	34	38	34	37	20	6		31					45	31
7	36	40	35	39	21	7		32					46	32
8	38	41	37	42	22	8		33					47	33
9	40	42	38	44	23	9		34					47	34
10	42	44	40	47	24	10		35					48	35
11	43	45	42	49	24	11		36					49	36
12	45	47	43	51	25	12		37					50	37
13	47	48	45	53	26	13		38					51	38
14	49	50	47	56	27	14		39					52	39
15	51	51	49	58	28	15		40					53	40
16	53	53	51	60	29	16		41					54	41
17	54	55	53	62	30	17		42					54	42
18	56	56	55	64	31	18		43					55	43
19	58	58	57	66	32	19		44					56	44
20	60	60	59	69	33	20		45					57	45
21	61	61	61		34	21		46					58	46
22	63	63	63		35	22		47					59	47
23	65	64	65		37	23		48					60	48
24	67	66	67		38	24		49					61	49
								50					62	50

Table 42

**ASVAB Form 22a Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	25	20	20	20	22	0	45					60	49	45
1	20	27	20	20	20	22	1	46					61	50	46
2	22	28	20	22	20	23	2	47					61	51	47
3	24	29	20	24	20	23	3	48					61	51	48
4	26	30	21	27	20	24	4	49					62	52	49
5	28	31	22	30	20	24	5	50					62	53	50
6	30	33	24	33	21	25	6	51						53	51
7	32	34	25	37	22	26	7	52						54	52
8	34	36	26	40	23	26	8	53						54	53
9	36	37	27	43	24	27	9	54						55	54
10	38	38	29	46	25	27	10	55						56	55
11	40	40	30	49	26	28	11	56						56	56
12	42	41	31	51	27	29	12	57						57	57
13	44	43	33	54	28	29	13	58						57	58
14	46	44	34	57	29	30	14	59						58	59
15	47	45	36	60	30	31	15	60						59	60
16	49	47	37		31	31	16	61						59	61
17	51	48	39		32	32	17	62						60	62
18	53	49	40		34	33	18	63						61	63
19	55	51	41		35	33	19	64						61	64
20	57	52	43		36	34	20	65						62	65
21	59	54	44		37	35	21	66						62	66
22	62	55	45		38	35	22	67						63	67
23	64	56	46		39	36	23	68						64	68
24	66	58	47		40	36	24	69						64	69
25	68	59	49		42	37	25	70						65	70
26		60	50		43	38	26	71						66	71
27		62	51		44	38	27	72						66	72
28		63	52		45	39	28	73						67	73
29		65	54		46	40	29	74						67	74
30		66	55		47	40	30	75						68	75
31			56		48	41	31	76						68	76
32			57		49	42	32	77						69	77
33			59		50	42	33	78						69	78
34			60		51	43	34	79						70	79
35			61		52	43	35	80						70	80
36					53	44	36	81						71	81
37					54	45	37	82						71	82
38					55	45	38	83						71	83
39					56	46	39	84						72	84
40					57	46	40	85							85
41					58	47	41	86							86
42					59	48	42	87							87
43					60	48	43	88							88
44					60	49	44	89							89

(continued)

Table 42
(continued)

**ASVAB Form 22a Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	AS	MK	MC	EI	VE	Raw		Raw	AS	MK	MC	EI	VE	Raw
0	24	29	23	23	20	0		25	69	67	70		38	25
1	26	31	25	25	20	1		26					39	26
2	28	32	27	28	20	2		27					40	27
3	30	34	28	30	20	3		28					41	28
4	32	36	30	32	20	4		29					42	29
5	33	37	32	34	20	5		30					43	30
6	35	39	33	37	20	6		31					44	31
7	37	40	35	39	21	7		32					45	32
8	39	42	37	41	22	8		33					46	33
9	40	43	39	44	23	9		34					47	34
10	42	44	40	46	24	10		35					48	35
11	44	46	42	48	25	11		36					49	36
12	45	47	44	51	26	12		37					49	37
13	47	49	46	53	26	13		38					50	38
14	49	50	48	55	27	14		39					51	39
15	50	51	50	58	28	15		40					52	40
16	52	53	52	60	29	16		41					53	41
17	54	54	54	62	30	17		42					54	42
18	56	55	56	64	31	18		43					55	43
19	57	57	58	66	32	19		44					56	44
20	59	58	60	69	33	20		45					57	45
21	61	60	62		34	21		46					58	46
22	63	61	64		35	22		47					59	47
23	64	63	66		36	23		48					60	48
24	66	65	68		37	24		49					61	49
								50					62	50

Table 43

**ASVAB Form 22b Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

Raw	GS	AR	WK	PC	NO	CS	Raw	Raw	GS	AR	WK	PC	NO	CS	Raw
0	20	26	20	20	20	22	0	45					60	49	45
1	20	27	20	21	20	22	1	46					61	50	46
2	22	28	20	24	20	23	2	47					61	51	47
3	24	30	21	27	20	23	3	48					61	51	48
4	26	31	22	30	20	24	4	49					62	52	49
5	28	32	23	33	20	24	5	50					62	53	50
6	30	34	25	37	21	25	6	51						53	51
7	32	35	26	40	22	26	7	52						54	52
8	34	36	28	43	23	26	8	53						54	53
9	36	38	29	46	24	27	9	54						55	54
10	38	39	31	48	25	27	10	55						56	55
11	40	40	32	51	26	28	11	56						56	56
12	42	42	34	54	27	29	12	57						57	57
13	44	43	35	56	28	29	13	58						57	58
14	46	44	36	59	29	30	14	59						58	59
15	47	45	37	62	30	31	15	60						59	60
16	49	47	38		31	31	16	61						59	61
17	51	48	40		32	32	17	62						60	62
18	53	49	41		34	33	18	63						61	63
19	55	51	42		35	33	19	64						61	64
20	57	52	43		36	34	20	65						62	65
21	59	53	44		37	35	21	66						62	66
22	62	54	45		38	35	22	67						63	67
23	64	56	46		39	36	23	68						64	68
24	66	57	47		40	36	24	69						64	69
25	68	59	49		42	37	25	70						65	70
26		60	50		43	38	26	71						66	71
27		61	51		44	38	27	72						66	72
28		63	52		45	39	28	73						67	73
29		64	54		46	40	29	74						67	74
30		66	55		47	40	30	75						68	75
31			56		48	41	31	76						68	76
32			57		49	42	32	77						69	77
33			59		50	42	33	78						69	78
34			60		51	43	34	79						70	79
35			61		52	43	35	80						70	80
36					53	44	36	81						71	81
37					54	45	37	82						71	82
38					55	45	38	83						71	83
39					56	46	39	84						72	84
40					57	46	40	85							85
41					58	47	41	86							86
42					59	48	42	87							87
43					60	48	43	88							88
44					60	49	44	89							89

(continued)

Table 43
(continued)

**ASVAB Form 22b Conversion of Raw Test Scores
to 1980 Standard Score Equivalents**

<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>	<u> </u>	<u>Raw</u>	<u>AS</u>	<u>MK</u>	<u>MC</u>	<u>EI</u>	<u>VE</u>	<u>Raw</u>
0	24	29	23	23	20	0		25	69	67	70		40	25
1	26	31	25	25	20	1		26					41	26
2	28	32	27	28	20	2		27					42	27
3	30	34	28	30	20	3		28					43	28
4	32	36	30	32	20	4		29					43	29
5	33	37	32	34	20	5		30					44	30
6	35	39	33	37	21	6		31					45	31
7	37	40	35	39	22	7		32					46	32
8	39	42	37	41	23	8		33					47	33
9	40	43	39	44	24	9		34					48	34
10	42	45	40	46	25	10		35					49	35
11	44	46	42	48	26	11		36					49	36
12	45	48	44	51	27	12		37					50	37
13	47	50	46	53	28	13		38					51	38
14	49	51	48	55	29	14		39					52	39
15	50	53	50	58	30	15		40					53	40
16	52	54	52	60	31	16		41					54	41
17	54	55	54	62	32	17		42					55	42
18	56	57	56	64	34	18		43					55	43
19	57	58	58	66	34	19		44					56	44
20	59	59	60	69	35	20		45					57	45
21	61	61	62		36	21		46					58	46
22	63	62	64		37	22		47					59	47
23	64	64	66		38	23		48					60	48
24	66	65	68		39	24		49					61	49
								50					62	50

Table 44

ASVAB Test Score Composites

<u>Service</u>	<u>Composite</u>	<u>Definition</u>
All	AFQT	2VE + AR + MK
Army	GT	VE + AR
	GM	MK + EI + AS + GS
	EL	AR + MK + EI + GS
	CL	AR + MK + VE
	MM	NO + AS + MC + EI
	SC	AR + AS + MC + VE
	CO	CS + AR + MC + AS
	FA	AR + CS + MC + MK
	OF	NO + AS + MC + VE
	ST	VE + MK + MC + GS
Navy	EL	AR + MK + EI + GS
	E	AR + GS + 2MK
	CL	NO + CS + VE
	GT	VE + AR
	ME	VE + MC + AS
	EG	MK + AS
	CT	VE + AR + NO + CS
	HM	VE + MK + GS
	ST	VE + AR + MC
	MR	AR + MC + AS
	BC	VE + MK + CS
Air Force	M	MC + GS + 2AS
	A	NO + CS + VE
	G	VE + AR
	E	AR + MK + EI + GS
Marine Corps	MM	AR + EI + MC + AS
	CL	VE + MK + CS
	GT	VE + AR + MC
	EL	AR + MK + EI + GS

Table 45

Composite Cutting Scores Used to Classify Subjects

<u>Composite</u>		<u>Category Upper Bounds</u>
AFQT*	2VE + AR + MK	09/15/20/30/49/64/92/99
ARMY**		
GT	VE + AR	109/160
GM	MK + EI + AS + GS	84/89/94/99/104/160
EL	AR + MK + EI + GS	84/89/94/99/104/109/114/119/160
CL	AR + MK + VE	84/89/94/99/104/109/160
MM	NO + AS + MC + EI	84/94/99/104/160
SC	AR + AS + MC + VE	89/94/99/104/160
CO	CS + AR + MC + AS	84/89/94/99/160
FA	AR + CS + MC + MK	84/89/94/99/160
OF	NO + AS + MC + VE	89/94/99/104/160
ST	VE + MK + MC + GS	84/89/94/99/104/109/114/160
NAVY***		
EL	AR + MK + EI + GS	189/199/203/217/320
E	AR + GS + 2MK	195/199/203/209/213/320
CL	NO + CS + VE	159/240
GT	VE + AR	88/95/96/102/107/112/114/160
ME	VE + MC + AS	149/157/166/240
EG	MK + AS	95/160
CT	VE + AR + NO + CS	201/320
HM	VE + MK + GS	148/164/240
ST	VE + AR + MC	146/240
MR	AR + MC + AS	129/157/163/240
BC	VE + MK + CS	146/152/240
AIR FORCE*		
M	MC + GS + 2AS	43/44/50/56/60/88/99
A	NO + CS + VE	26/31/39/44/50/60/66/99
G	VE + AR	29/34/38/41/42/47/49/52/55/57/63/68/69/99
E	AR + MK + EI + GS	32/38/42/44/45/49/57/66/71/76/80/99
MARINE CORPS**		
MM	AR + EI + MC + AS	84/94/104/114/160
CL	VE + MK + CS	79/89/99/109/119/160
GT	VE + AR + MC	79/89/99/109/160
EL	AR + MK + EI + GS	89/99/109/114/160
STUDENT AA (= AFQT****)		
GRADE 10		39/44/49/56/80
GRADE 11		40/47/52/59/80
GRADE 12		43/48/54/60/80

* Percentile Scores

** Standard Scores (Mean=100, S.D.=20)

*** Sum of Test Standard Scores

**** Standard Scores (Mean=50, S.D.=10)

Table 46

Answer-Sheet by Composite-Category Chi-Squares for ASVAB Reference Form (15c)

<u>Composite</u>	<u>Chi-Square</u>	<u>Degrees of Freedom</u>	<u>Probability</u>
AFQT	7.216	7	.407
<u>Army</u>			
GT	0.144	1	.705
GM	4.948	5	.422
EL	10.410	8	.237
CL	7.162	6	.306
MM*	6.560	4	.161
SC	1.579	4	.813
CO*	6.000	4	.199
FA*	3.288	4	.511
OF*	1.156	4	.885
ST	12.122	7	.097
<u>Navy</u>			
EL	11.501	4	.021
E	2.333	5	.801
CL*	0.794	1	.373
GT	9.240	7	.236
ME	1.613	3	.656
EG	1.379	1	.240
CT*	1.438	1	.231
HM	4.676	2	.097
ST	0.008	1	.930
MR	1.587	3	.662
BC*	4.857	2	.088
<u>Air Force</u>			
M	4.706	6	.582
A*	5.559	7	.592
G	10.378	12	.583
E	9.260	11	.598
<u>Marine Corps</u>			
MM	2.180	4	.703
CL*	7.119	5	.212
GT	4.700	4	.320
EL	4.991	4	.288

* Composite includes NO and/or CS.

ASVAB OMR IOT&E SUPPLEMENT FIGURES 1-10

LAST

PART

M

LAST NAME

FIRST NAME

MIDDLE NAME

DATE

TIME

GRADE

AGE

SEX

RACE

RELIGION

MARRIED

SINGLE

DIVORCED

WIDOWED

OTHER

ARMED SERVICES VOCATIONAL APTITUDE BATTERY

PAGE 1

PART 1-AS		PART 2-AS		PART 3-WK		PART 4-PC		PART 5-MO	
1	2	1	2	1	2	1	2	1	2
1	2	1	2	1	2	1	2	1	2
3	4	3	4	3	4	3	4	3	4
5	6	5	6	5	6	5	6	5	6
7	8	7	8	7	8	7	8	7	8
9	10	9	10	9	10	9	10	9	10
11	12	11	12	11	12	11	12	11	12
13	14	13	14	13	14	13	14	13	14
15	16	15	16	15	16	15	16	15	16
17	18	17	18	17	18	17	18	17	18
19	20	19	20	19	20	19	20	19	20
21	22	21	22	21	22	21	22	21	22
23	24	23	24	23	24	23	24	23	24
25	26	25	26	25	26	25	26	25	26
27	28	27	28	27	28	27	28	27	28
29	30	29	30	29	30	29	30	29	30
31	32	31	32	31	32	31	32	31	32
33	34	33	34	33	34	33	34	33	34
35	36	35	36	35	36	35	36	35	36
37	38	37	38	37	38	37	38	37	38
39	40	39	40	39	40	39	40	39	40
41	42	41	42	41	42	41	42	41	42
43	44	43	44	43	44	43	44	43	44
45	46	45	46	45	46	45	46	45	46
47	48	47	48	47	48	47	48	47	48
49	50	49	50	49	50	49	50	49	50

LAST

FIRST

MIDDLE

DATE

TIME

LAST NAME

FIRST NAME

MIDDLE NAME

DATE

TIME

GRADE

AGE

SEX

RACE

RELIGION

MARRIED

SINGLE

DIVORCED

WIDOWED

OTHER

ARMED SERVICES VOCATIONAL APTITUDE BATTERY

PAGE 1

Figure 1: Vertical-Response Answer Sheet for Enlistment ASVAB (Page 1, Reduced)

1100 A

CONFIDENTIAL! FOR THE EYES OF THE PRESIDENT ONLY

CONTROLLED ITEM TEST MATERIAL (WHEN COMPLETED)

S-74

																		ANSWER SHEET										PAGE 3									
																		ARMED SERVICES VOCATIONAL APTITUDE BATTERY																			
PART 9-A						1 A B C D		5 A B C D		9 A B C D		13 A B C D		17 A B C D		21 A B C D		25 A B C D		SOCIAL SECURITY NO.																	
						2 A B C D		6 A B C D		10 A B C D		14 A B C D		18 A B C D		22 A B C D																					
						3 A B C D		7 A B C D		11 A B C D		15 A B C D		19 A B C D		23 A B C D																					
						4 A B C D		8 A B C D		12 A B C D		16 A B C D		20 A B C D		24 A B C D																					
						1 A B C D		5 A B C D		9 A B C D		13 A B C D		17 A B C D		21 A B C D		25 A B C D																			
PART 9-B						1 A B C D		5 A B C D		9 A B C D		13 A B C D		17 A B C D		21 A B C D		25 A B C D		SOCIAL SECURITY NO.																	
						2 A B C D		6 A B C D		10 A B C D		14 A B C D		18 A B C D		22 A B C D																					
						3 A B C D		7 A B C D		11 A B C D		15 A B C D		19 A B C D		23 A B C D																					
						4 A B C D		8 A B C D		12 A B C D		16 A B C D		20 A B C D		24 A B C D																					
						1 A B C D		5 A B C D		9 A B C D		13 A B C D		17 A B C D		21 A B C D		25 A B C D																			
PART 10-A						1 A B C D		4 A B C D		7 A B C D		10 A B C D		13 A B C D		16 A B C D		19 A B C D		SOCIAL SECURITY NO.																	
						2 A B C D		5 A B C D		8 A B C D		11 A B C D		14 A B C D		17 A B C D		20 A B C D																			
						3 A B C D		6 A B C D		9 A B C D		12 A B C D		15 A B C D		18 A B C D		21 A B C D																			
						4 A B C D		7 A B C D		10 A B C D		13 A B C D		16 A B C D		19 A B C D		22 A B C D																			
						1 A B C D		4 A B C D		7 A B C D		10 A B C D		13 A B C D		16 A B C D		19 A B C D																			
<p>PRIVACY ACT STATEMENT</p> <p>AUTHORITY: 44 USC 3183, 10 USC 133, 18 USC 3612, EOB 397</p> <p>PRINCIPAL PURPOSE: To request the administration of an enlistment qualification examination. Your social security number is used to positively identify qualification results.</p> <p>ROUTINE USE: To compute and verify test scores to determine eligibility for enlistment in the Armed Forces and provide scores to recruiting services. To provide data to DOS agencies and appropriate outside activities for compilation or research purposes.</p> <p>DISCLOSURE: Disclosure is mandatory. If you fail to answer any or all of these personal questions, you will not be allowed to take the test.</p>																																					
<p>I certify that I am physically and mentally fit and that I have neither given nor received unauthorized assistance in conjunction with this test.</p>																																					
SIGNATURE																																					

POPULATION GROUP

☐ AMERICAN INDIAN
☐ HAWAIIAN
☐ ASIAN
☐ BLACK
☐ WHITE
☐ OTHER

TEST NO.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

ALL SP STUDENT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

U.S. ARMY		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

SOCIAL SECURITY NO.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

U.S. NAVY		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

U.S. AIR FORCE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
-----------------------	--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Figure 1: Vertical-Response Answer Sheet for Enlistment ASVAB (Page 3, Reduced)

ASP TEST VERSION		ASP DATE		ASP TEST TYPE	
ASP TEST VERSION	ASP DATE	ASP TEST TYPE	ASP TEST TYPE	ASP TEST TYPE	ASP TEST TYPE
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48
49	50	51	52	53	54
55	56	57	58	59	60
61	62	63	64	65	66
67	68	69	70	71	72
73	74	75	76	77	78
79	80	81	82	83	84
85	86	87	88	89	90
91	92	93	94	95	96
97	98	99	100	101	102
103	104	105	106	107	108
109	110	111	112	113	114
115	116	117	118	119	120
121	122	123	124	125	126
127	128	129	130	131	132
133	134	135	136	137	138
139	140	141	142	143	144
145	146	147	148	149	150
151	152	153	154	155	156
157	158	159	160	161	162
163	164	165	166	167	168
169	170	171	172	173	174
175	176	177	178	179	180
181	182	183	184	185	186
187	188	189	190	191	192
193	194	195	196	197	198
199	200	201	202	203	204
205	206	207	208	209	210
211	212	213	214	215	216
217	218	219	220	221	222
223	224	225	226	227	228
229	230	231	232	233	234
235	236	237	238	239	240
241	242	243	244	245	246
247	248	249	250	251	252
253	254	255	256	257	258
259	260	261	262	263	264
265	266	267	268	269	270
271	272	273	274	275	276
277	278	279	280	281	282
283	284	285	286	287	288
289	290	291	292	293	294
295	296	297	298	299	300
301	302	303	304	305	306
307	308	309	310	311	312
313	314	315	316	317	318
319	320	321	322	323	324
325	326	327	328	329	330
331	332	333	334	335	336
337	338	339	340	341	342
343	344	345	346	347	348
349	350	351	352	353	354
355	356	357	358	359	360
361	362	363	364	365	366
367	368	369	370	371	372
373	374	375	376	377	378
379	380	381	382	383	384
385	386	387	388	389	390
391	392	393	394	395	396

Figure 1: Vertical-Response Answer Sheet for Enlistment ASVAB (Page 4, Reduced)

SIGNATURE	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="width: 100%; text-align: center;">TA ID NUMBER</div> </div> </div> <div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="width: 100%; text-align: center;">SOCIAL SECURITY NO.</div> </div> </div> </div>									
MI	PART 8-AK									
	1 A B C D	5 A B C D	9 A B C D	13 A B C D	17 A B C D	21 A B C D	25 A B C D			
	2 A B C D	6 A B C D	10 A B C D	14 A B C D	18 A B C D	22 A B C D				
	3 A B C D	7 A B C D	11 A B C D	15 A B C D	19 A B C D	23 A B C D				
FIRST	PART 9-AC									
	1 A B C D	5 A B C D	9 A B C D	13 A B C D	17 A B C D	21 A B C D	25 A B C D			
	2 A B C D	6 A B C D	10 A B C D	14 A B C D	18 A B C D	22 A B C D				
	3 A B C D	7 A B C D	11 A B C D	15 A B C D	19 A B C D	23 A B C D				
LAST	PART 10-BI									
	1 A B C D	4 A B C D	7 A B C D	10 A B C D	13 A B C D	16 A B C D	19 A B C D			
	2 A B C D	5 A B C D	8 A B C D	11 A B C D	14 A B C D	17 A B C D	20 A B C D			
	3 A B C D	6 A B C D	9 A B C D	12 A B C D	15 A B C D	18 A B C D				
SSN	<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center; margin: 0;">PRIVACY ACT STATEMENT</p> <p style="margin: 5px 0;">AUTHORITY: 44USC3103, 10USC133, 10USC3012, E08397</p> <p style="margin: 5px 0;">PRINCIPAL PURPOSE: To request the administration of an enlistment qualification examination. Your social security number is used to positively identify qualification results.</p> <p style="margin: 5px 0;">ROUTINE USE: To compute and verify test scores to determine eligibility for enlistment in the Armed Forces and provide scores to recruiting services. To provide data to DOD agencies and appropriate outside activities for compilation or research purposes.</p> <p style="margin: 5px 0;">DISCLOSURE: Disclosure is mandatory. If you fail to answer any or all of these personal questions, you will not be allowed to take the test.</p> <p style="margin: 10px 0;">I certify that I am physically and mentally fit and that I have neither given nor received unauthorized assistance in conjunction with this test.</p> <div style="border-top: 1px solid black; margin-top: 10px; text-align: center;">SIGNATURE</div> </div>									
	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="width: 100%; text-align: center;">TEST NO.</div> </div> </div> <div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="width: 100%; text-align: center;">SP STUDIES</div> </div> </div> </div>									
	<div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="width: 100%; text-align: center;">POPULATION GROUP</div> </div> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="width: 100%;"> <input type="radio"/> AMER INDIAN <input type="radio"/> HISPANIC <input type="radio"/> ASIAN <input type="radio"/> BLACK <input type="radio"/> WHITE <input type="radio"/> OTHER </div> </div> </div>									

Figure 2: Circular-Response Answer Sheet for Enlistment ASVAB (Page 3, Reduced)

DO NOT MARK IN THIS BOX

SEQUENCE NUMBER

ASP TEST VERSION

ASP DATE

YR MO DAY

LAST NAME

ANSWER SHEET PAGE 4
ADAPTABILITY SCREENING
PROFILE

ASP TEST TYPE

INITIAL

VOLUNTARY RETEST

MANDATORY RETEST

SOCIAL SECURITY NO.

M	FIRST	PART 1	1 A B C D E 9 A B C D E 17 A B C D E 25 A B C D E 33 A B C D E 41 A B C D E 49 A B C D E
			2 A B C D E 10 A B C D E 18 A B C D E 26 A B C D E 34 A B C D E 42 A B C D E 50 A B C D E
			3 A B C D E 11 A B C D E 19 A B C D E 27 A B C D E 35 A B C D E 43 A B C D E
			4 A B C D E 12 A B C D E 20 A B C D E 28 A B C D E 36 A B C D E 44 A B C D E
			5 A B C D E 13 A B C D E 21 A B C D E 29 A B C D E 37 A B C D E 45 A B C D E
			6 A B C D E 14 A B C D E 22 A B C D E 30 A B C D E 38 A B C D E 46 A B C D E
			7 A B C D E 15 A B C D E 23 A B C D E 31 A B C D E 39 A B C D E 47 A B C D E
			8 A B C D E 16 A B C D E 24 A B C D E 32 A B C D E 40 A B C D E 48 A B C D E
LAST	PART 2	1 A B C 11 A B C 21 A B C 31 A B C 41 A B C 51 A B C 61 A B C	
		2 A B C 12 A B C 22 A B C 32 A B C 42 A B C 52 A B C 62 A B C	
		3 A B C 13 A B C 23 A B C 33 A B C 43 A B C 53 A B C 63 A B C	
		4 A B C 14 A B C 24 A B C 34 A B C 44 A B C 54 A B C 64 A B C	
		5 A B C 15 A B C 25 A B C 35 A B C 45 A B C 55 A B C 65 A B C	
		6 A B C 16 A B C 26 A B C 36 A B C 46 A B C 56 A B C 66 A B C	
		7 A B C 17 A B C 27 A B C 37 A B C 47 A B C 57 A B C 67 A B C	
		8 A B C 18 A B C 28 A B C 38 A B C 48 A B C 58 A B C 68 A B C	
		9 A B C 19 A B C 29 A B C 39 A B C 49 A B C 59 A B C 69 A B C	
		10 A B C 20 A B C 30 A B C 40 A B C 50 A B C 60 A B C 70 A B C	
SSN	PART 3	1 A B C D E 5 A B C D E 9 A B C D E 13 A B C D E 17 A B C D E 21 A B C D E 25 A B C D E	
		2 A B C D E 6 A B C D E 10 A B C D E 14 A B C D E 18 A B C D E 22 A B C D E 26 A B C D E	
		3 A B C D E 7 A B C D E 11 A B C D E 15 A B C D E 19 A B C D E 23 A B C D E 27 A B C D E	
		4 A B C D E 8 A B C D E 12 A B C D E 16 A B C D E 20 A B C D E 24 A B C D E 28 A B C D E	

MAY 91 DD FORM 1304-1AS CONTROLLED ITEM TEST MATERIAL (WHEN COMPLETED)

Figure 2: Circular-Response Answer Sheet for Enlistment ASVAB (Page 4, Reduced)

Figure 3
Answer Sheet Usage, By Total Number
Tested at Test Site

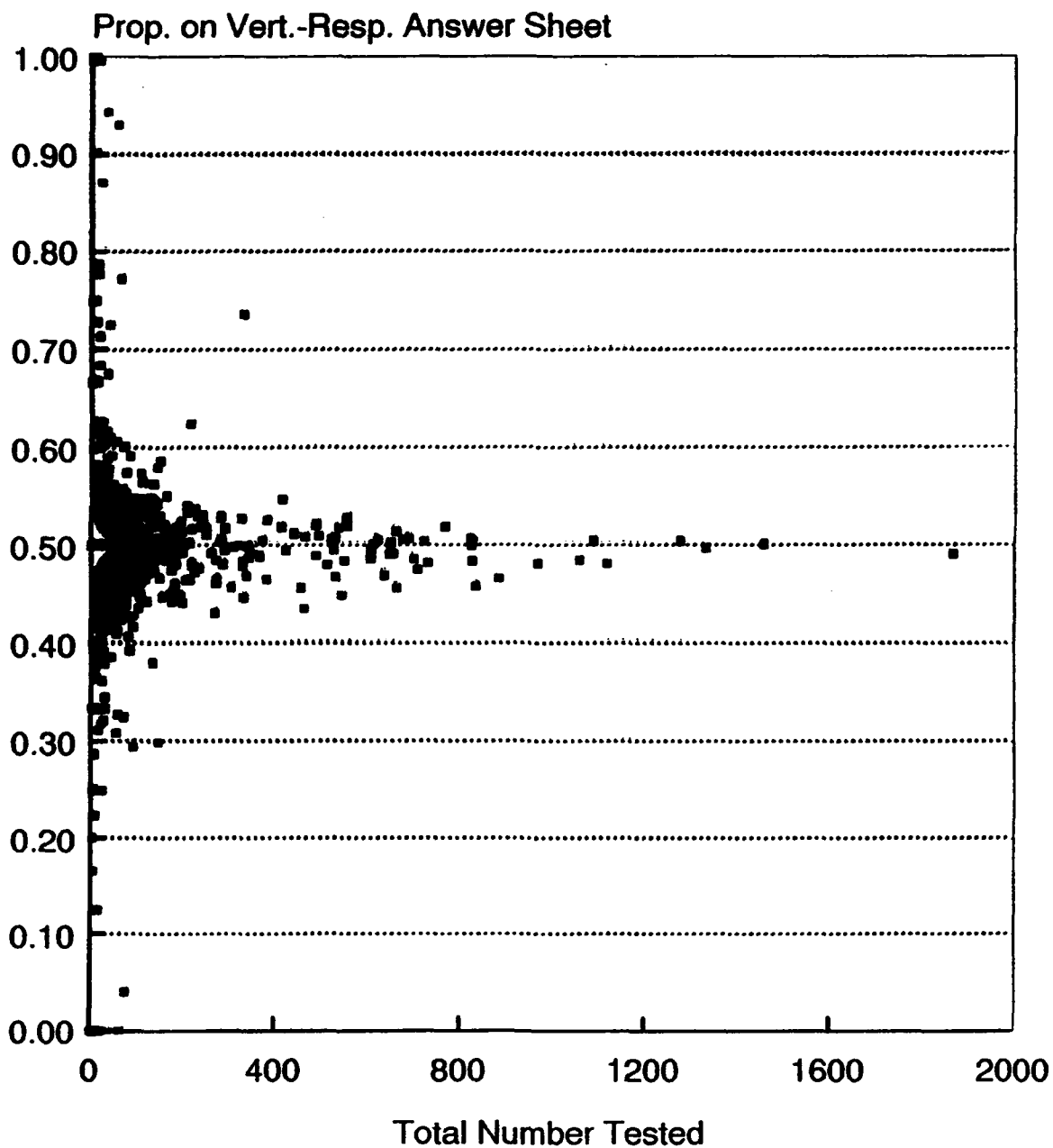


Figure 3: Answer Sheet Usage by Total Number Tested at a Test Site

Figure 4a
Unsmoothed and Smoothed: NO
Vertical-Response Answer Sheet Dist.

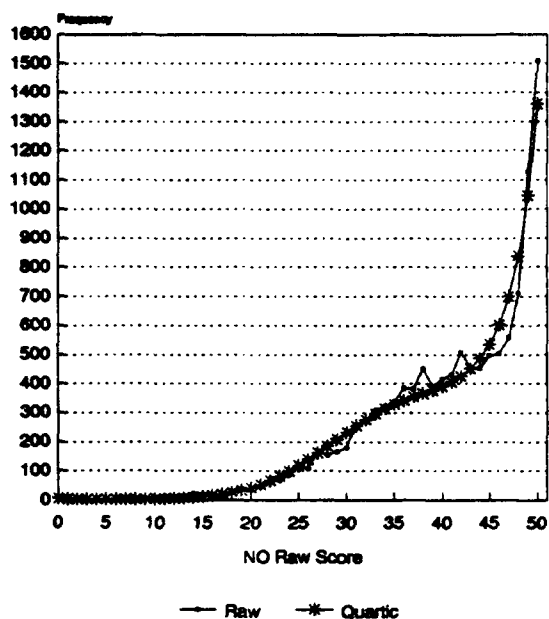


Figure 4b
Unsmoothed and Smoothed: NO
Vertical-Response Answer Sheet Dist.

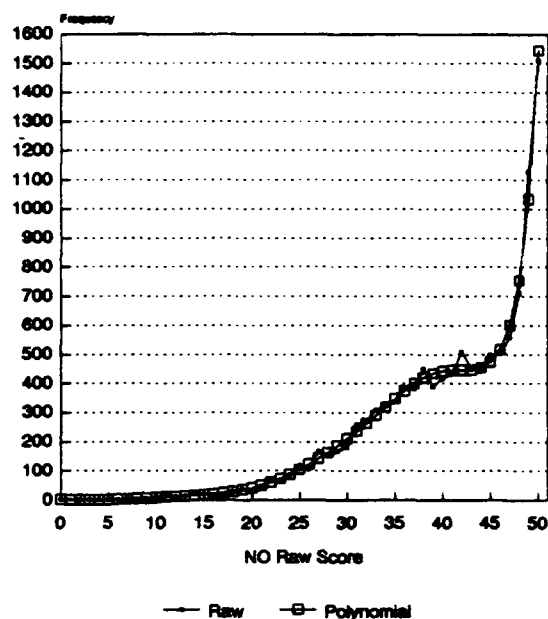


Figure 4c
Unsmoothed and Smoothed: NO
Circular-Response Answer Sheet Dist.

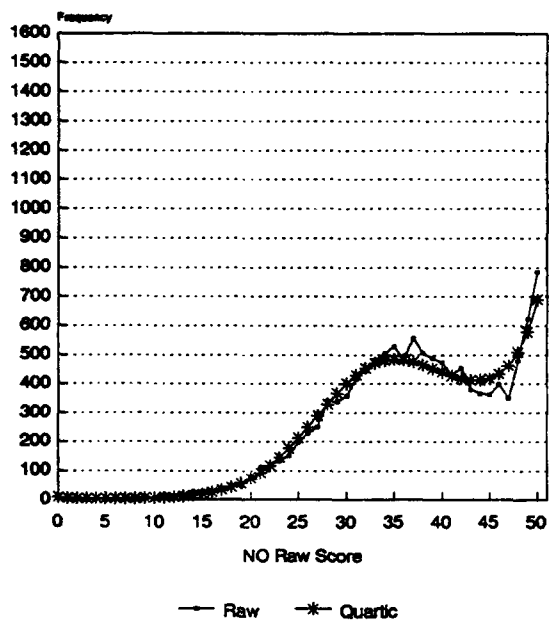


Figure 4d
Unsmoothed and Smoothed: NO
Circular-Response Answer Sheet Dist.

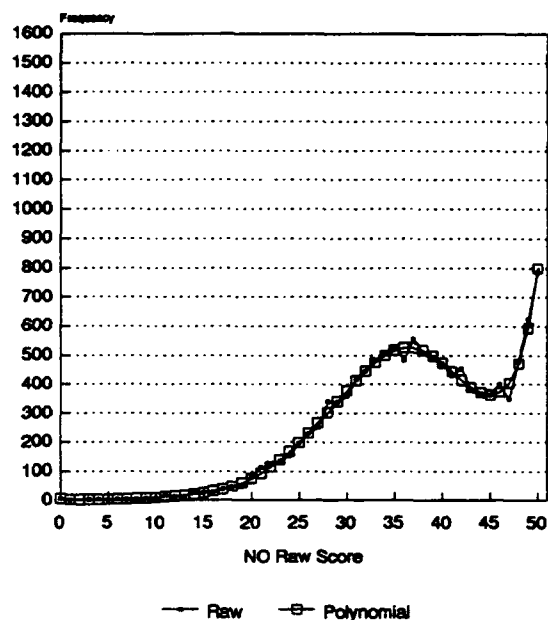


Figure 4: Unsmoothed and Quartic and Polynomial Log-Linear Smoothed Distributions for NO on Vertical- and Circular-Response Answer Sheets

Figure 5a
Unsmoothed and Smoothed: CS
Vertical-Response Answer Sheet Dist.

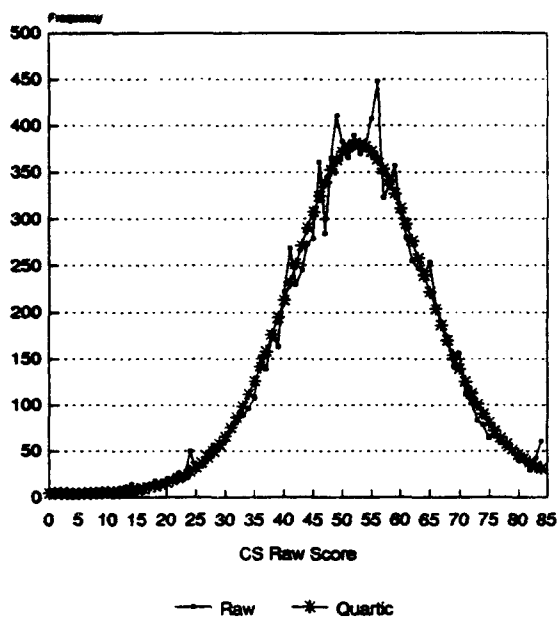


Figure 5b
Unsmoothed and Smoothed: CS
Vertical-Response Answer Sheet Dist.

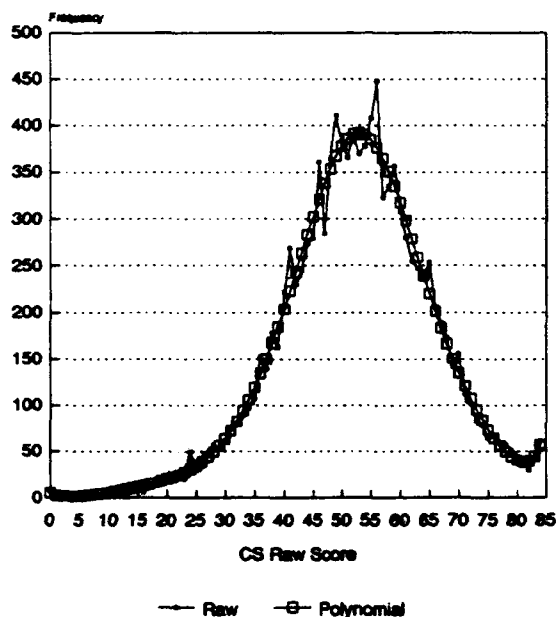


Figure 5c
Unsmoothed and Smoothed: CS
Circular-Response Answer Sheet Dist.

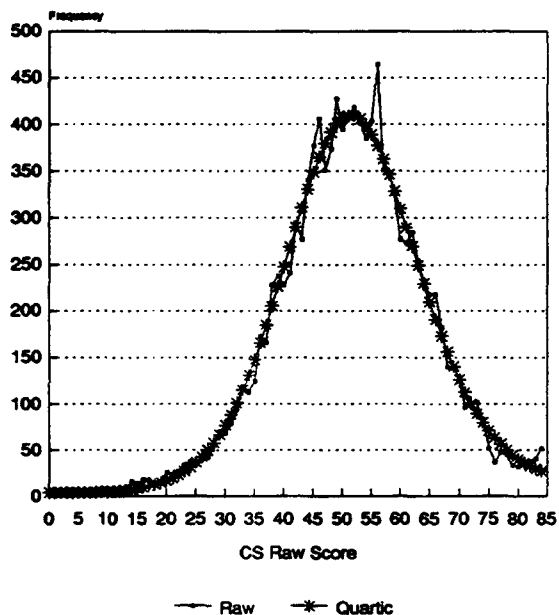


Figure 5d
Unsmoothed and Smoothed: CS
Circular-Response Answer Sheet Dist.

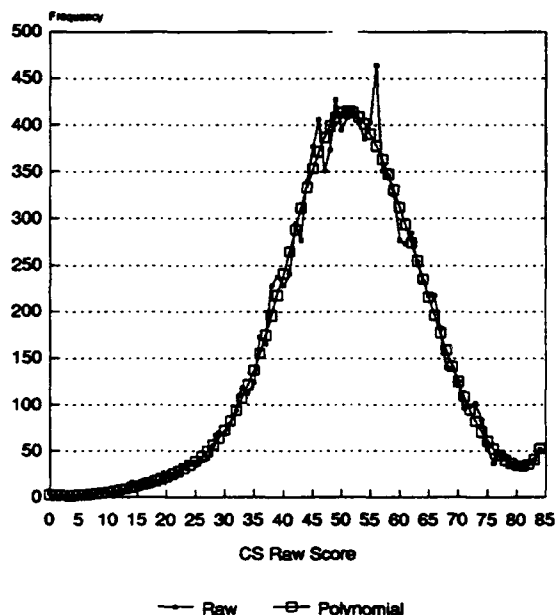


Figure 5: Unsmoothed and Quartic and Polynomial Log-Linear Smoothed Distributions for CS on Vertical- and Circular-Response Answer Sheets

Figure 6a
Standard Score Contrast of Alternative
Equatings With Identity Equatings: NO

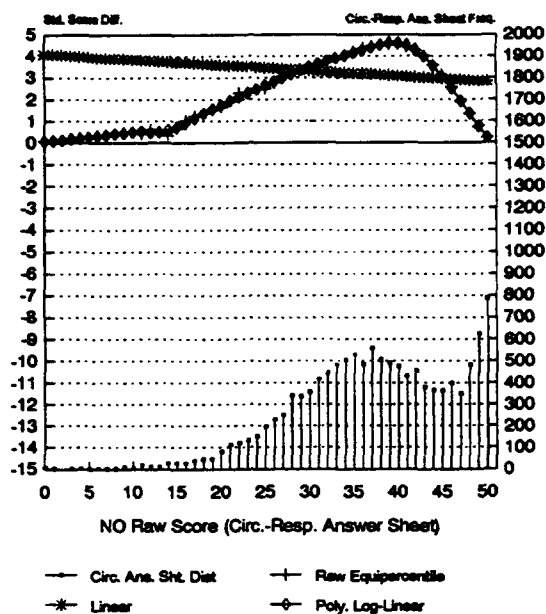


Figure 6b
Contrast of Equated-Score Distributions
With Vert.-Resp. Answer Sheet Dist.: NO

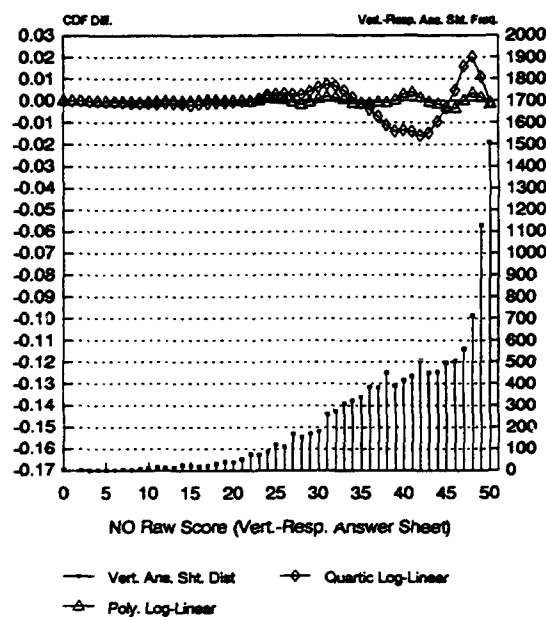


Figure 6: Standard Score Contrast of Alternative Equatings with Linear Identity Equating, and Contrasts of Equated-Score Distributions With Vertical-Response Answer Sheet Distribution, for NO

Figure 7a
Standard Score Contrast of Alternative
Equatings With Identity Equating: CS

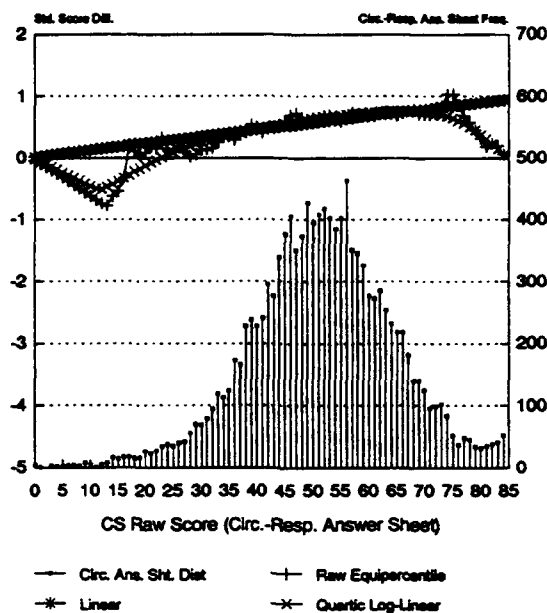


Figure 7b
Contrast of Equated Score Distributions
With Vert.-Resp. Answer Sheet Dist.: CS

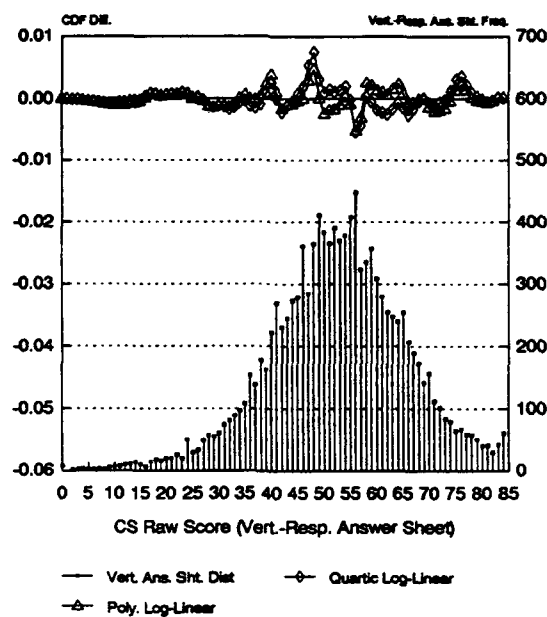


Figure 7: Standard Score Contrast of Alternative Equatings with Linear Identity Equating, and Contrasts of Equated-Score Distributions with Vertical-Response Answer Sheet Distribution, for CS

Figure 8a
Standard Score Contrast With Identity
Equating, With/Without Pooling Dists: NO

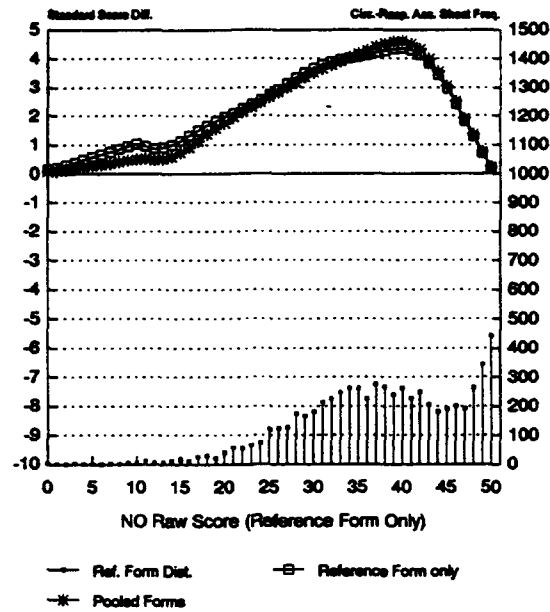


Figure 8b
Standard Score Contrast With Identity
Equating, With/Without Pooling Dists: CS

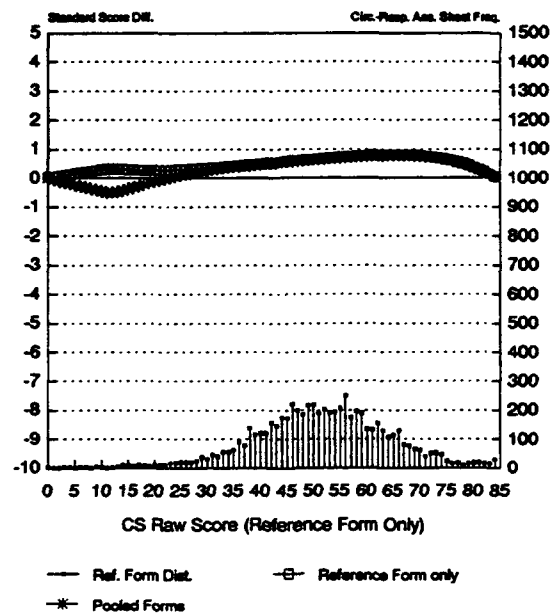
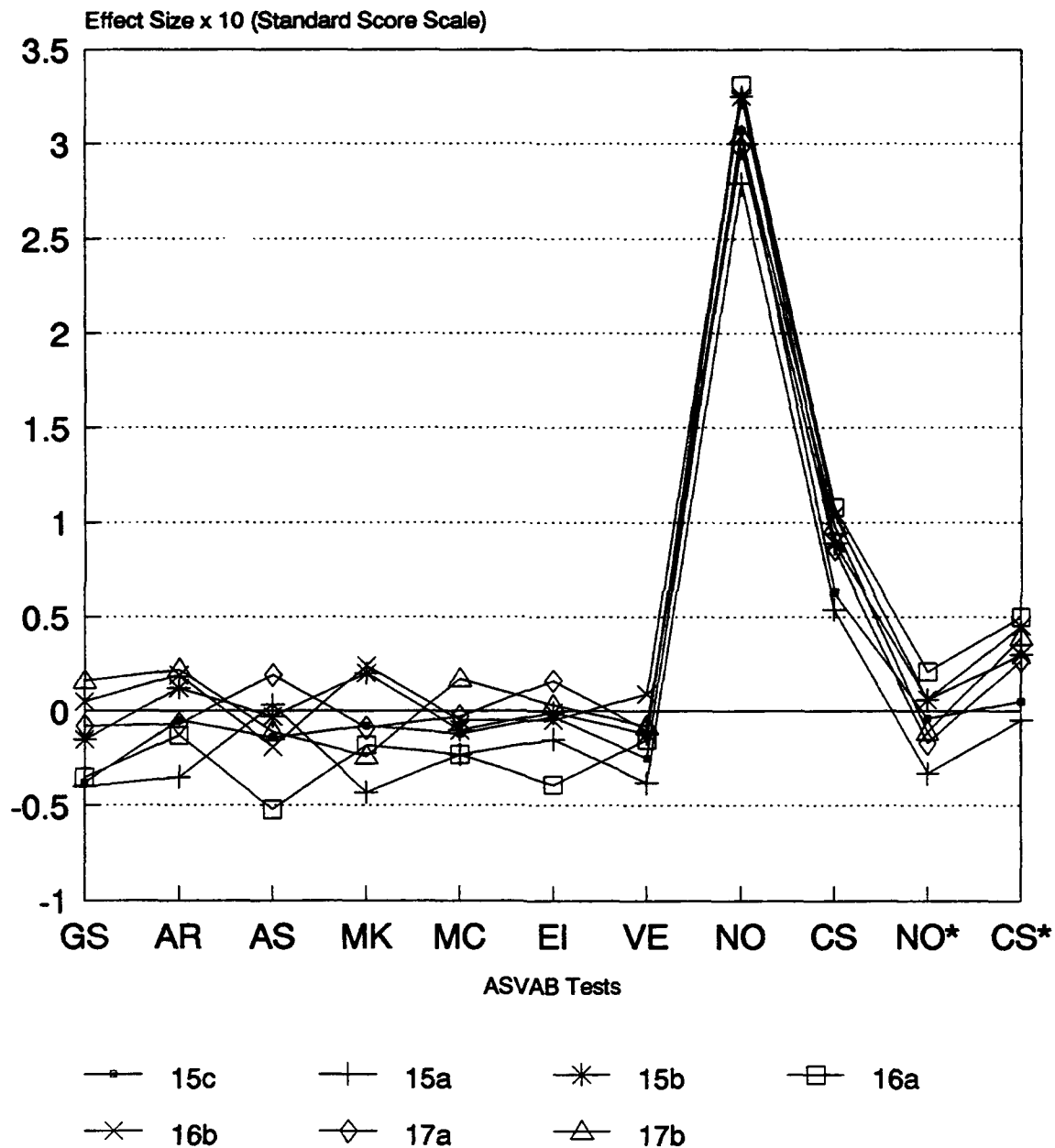


Figure 8: Standard Score Contrast of Selected Equatings with Linear Identity Equating, with and without Use of Pooled Distributions

Figure 9
Answer Sheet Effect Size
by ASVAB Form and Test



* After calibration.

Figure 9: Answer-Sheet Effect Size before and after Answer-Sheet Calibration, by ASVAB Form and Test

Figure 10a
Standard Score Contrast With Identity
Equating: Three Studies With NO

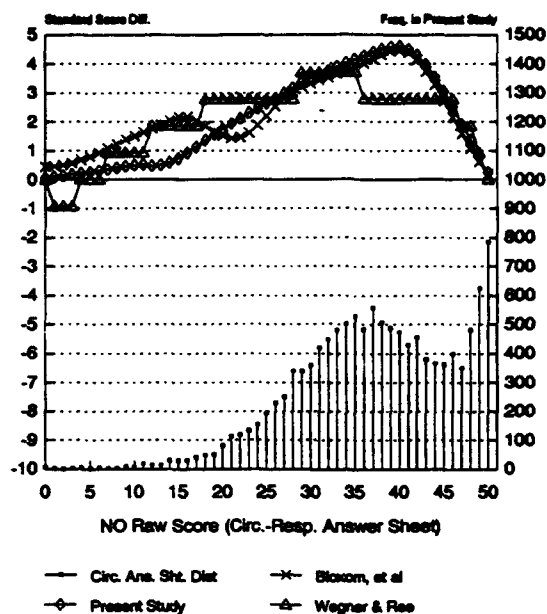


Figure 10b
Standard Score Contrast With Identity
Equating: Three Studies With CS

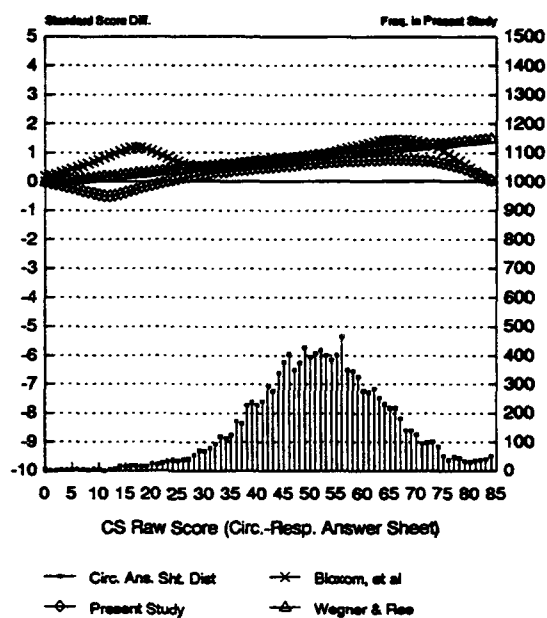


Figure 10: Standard Score Contrast of Equated Scores with Linear Identity Equating: Results of Three Answer-Sheet Studies